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(*Continued from 3d page of cover.*)

Vol. XI. Anthropology.

**Jesup North Pacific Expedition, Vol. VII.*

PART I.— The Chuckchee: Material Culture. By W. Bogoras. Pp. 1–276, pll. i–xxxi, 1 map, and 199 text figures. 1904. Price, $8.00.
PART II.— The Chuckchee: Religion. By W. Bogoras. Pp. 277–536, pll. xxxii–xxxiv, and 101 text figures. 1907. Price, $4.00.
PART III.— The Chuckchee: Social Organization. By W. Bogoras. Pp. 537–733, pl. xxxv, and 1 text figure. 1909. Price, $3.00.

Vol. XII. Anthropology (in preparation).

**Jesup North Pacific Expedition, Vol. VIII.*

Vol. XIII. Anthropology (in preparation).

**Jesup North Pacific Expedition, Vol. IX.*

Vol. XIV. Anthropology.

**Jesup North Pacific Expedition, Vol. X.*

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PART II.— Haida Texts. By John R. Swanton. Pp. 271–802, 1908. Price, $5.40.

ETHNOGRAPHICAL ALBUM.

Jesup North Pacific Expedition.

Ethnographical Album of the North Pacific Coasts of America and Asia. Part 1, pp. 1–5, pll. 1–28. August, 1900. Sold by subscription, price, $6.00.

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ERRATA.

Page 420, explanation of Fig. 8, for *Hyænodon brachygnathus* read *Hyænodon brachycephalus.*

" 422, in explanation of Fig. 9 E, omit the word type.

" " explanation of Fig. 9 G, for *Hyænodon brachygnathus* read *Hyænodon brachycephalus*, type.

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56.9, 73 A (1182: 78.3)

Article I.— OBSERVATIONS UPON THE GENUS ANCODON.

BY W. D. MATTHEW.

1. DESCRIPTION OF A NEW SPECIES FROM THE LOWER MIOCENE.

Ancodon (? = **Bothriodon**) **leptodus** sp. nov.

The genus *Ancodon* (*Bothriodon* or *Hyopotamus*) is characteristic of the Oligocene and Upper Eocene of Europe and Africa and of the Oligocene (White River group) in this country. It is also recorded in the Siwalik fauna of India. It has not been found in the uppermost Oligocene (John Day formation) in America, but the three faunal horizons of the White River have yielded three species well distinguished from each other and from any of the Old World species. These are:

A. brachyrhynchus (Osborn and Wortman 1894). Protoceras Beds.
A. rostratus Scott 1894. Oreodon Beds.
A. americanus (Leidy 1856). Titanotherium Beds.

In certain respects these species appear to be in direct succession; in others they do not. They show a progressive shortening of the muzzle accompanied by a slight decrease in size of the cheek teeth, the size of the skulls varying widely in each species. On the other hand the first upper premolar is small in *A. americanus*, absent in *A. rostratus*, but quite well developed in *A. brachyrhynchus*.

The American Museum Expedition of 1906 obtained an incomplete skull with lower jaws and parts of skeleton (No. 13005) of an *Ancodon*, from the Lower Rosebud beds which overlie the White River on the Pine Ridge Reservation in South Dakota. These beds constitute the lowest

member of the Arickaree formation in that locality and are referred from their fauna to the Lower Miocene (Matthew, 1907).

This specimen represents a fourth American species allied to *A. brachyrhynchus,* but with the muzzle somewhat shorter and the cheek teeth smaller. All the premolars are somewhat smaller and considerably more compressed, the inner crescents of the upper series and internal ridges of the lower series less developed. The inner ridge is absent upon p_1, rudimentary upon p_2, incomplete upon p_3 and apparently incomplete upon p_4. In *A. brachyrhynchus* it is rudimentary upon p_1, complete upon p_2, p_3 and p_4. The lower molars are decidedly narrower, but the heel of m_3 is broader. The upper molars are smaller and have no trace of the internal cingula which are present but incomplete in *A. brachyrhynchus.* The diastema between c_1 and p_1 is about half as long as that between p_1 and p_2; in *A. brachyrhynchus* these diastemata are subequal. The species differs from *A. rostratus* and *A. americanus* in the much shorter muzzle and well developed two rooted p^1 in addition to the characters above cited. Among the European species, *A. velaunus* and *leptorhynchus* of the Lower Oligocene have long slender muzzles like the Middle and Lower Oligocene American species, with which they correspond in the cheek teeth except for slightly smaller size, spacing of p^1 and other minor characters. *A. borbonicus* and *porcinus* of the Middle Oligocene appear to have short muzzles as in *A. brachyrhynchus* and *leptodus,* but are smaller, especially *A. porcinus,* and are very imperfectly known, so that exact comparison is difficult. The Upper Eocene species *A. crispus* and *gresslyi* are much smaller with very short-crowned teeth and other points of difference, so that they are now regarded as a distinct genus (*Tapinodon*). *A. gorringei* and *parvus* of the Upper Eocene of Egypt are like *A. velaunus* except for smaller size and more brachydont teeth.

The portions of the skeleton preserved in the type of *A. leptodus* are three cervical vertebræ, the last five lumbars, sacrum, pelvis, calcaneum and navicular. They add very little to what is already known of the osteology of the genus as given by Scott in 1894. The posterior lumbars are remarkable for the unusually long neural spines, projecting strongly forward and decreasing in width to the tip. This is quite different from the type of spine on a lumbar vertebra referred by Andrews (1906) to this genus; but as Andrews's specimen appears to be an anterior lumbar, it may be that the character of the spines changes anteriorly. The zygapophyses are slightly revolute on the first and last two of the series of five lumbars, but not on the intermediate ones. The sacrum consists of three vertebræ, of which the first chiefly supports the pelvis, the second contributing to but a slight extent to the articulating surface. It is relatively

short and wide, the second and third vertebræ much reduced — more so than in *Sus*. The pelvis resembles that of *Sus* much more than it does any of the Oreodontidæ, and corresponds quite nearly to the pelvis of *A. gorringei* figured by Andrews.

The characters of lumbars, pelvis, and foot-bones in *Ancodon* indicate to my mind a much nearer relationship to the Suidæ than to the Oreodontidæ.

2. Distribution of Ancodon and Related Genera.

The distribution of the known species of *Ancodon* and the related genera *Tapinodon, Arretotherium* and *Merycopotamus* is as follows:

	Europe.[2]	Africa.	Asia.	N. America.
Upper Miocene			Merycopotamus. A. giganteus,[1] etc	
Middle "				
Lower "				Arretotherium. A. leptodus.
Upper Oligocene				A. brachyrhynchus.
Middle "	A. borbonicus.[4] A. porcinus.			A. rostratus.
Lower "	A. velaunus.[5] A. leptorhynchus, etc.			A. americanus.
Upper Eocene	? A. crispus.[6]	A. gorringei.[3] A. parvus.		
Middle "	Tapinodon.[7]			

From the above table it will appear that while ancestral forms of *Ancodon* occur in the Upper and Middle Eocene of Europe, none are recognized in the American Eocene. The genus is common in the uppermost Eocene of

[1] Lower Siwalik (Bugti beds) of India.
[2] The horizons of the European species are correlated auct. Depéret, 1908.
[3] Fluvio-marine beds of the Fayum, Egypt. Regarded by some authorities as Lower Oligocene.
[4] These species are from St. Pourçain-sur-Bebre and Digoin in the basin of the Loire.
[5] These species are from Ronzon, France, and Hempstead, Isle of Wight (*A. bovinus*, etc.).
[6] St. Euzet-les-Bains (Gard.), France.
[7] Egerkingen, Switzerland, *T. gresslyi* et al.; also Mauremont.

Africa, but no predecessors are found there in the fauna of the underlying beds. As has been seen, the American species are apparently not in absolutely direct genetic sequence although nearly so. They occur in four successive levels in the same region, and their geological sequence is beyond question. All of them are known from fairly complete material — skulls, jaws and more or less of the skeleton. The species of the European Oligocene appear to parallel those of the American Oligocene in their evolution, but to be somewhat more advanced at corresponding epochs. The African species are most nearly related to those of the European Lower Oligocene but somewhat more primitive. The species of the European Eocene are much more primitive, but imperfectly known so that we cannot be sure whether they are directly ancestral or not. We know nothing of the presence or absence of the genus in Asia during the early Tertiary, unless some of the species which have been referred to the Siwalik fauna belong to older faunæ, possibly as far back as the Oligocene.

On present evidence we must regard the genus as of Old World origin, probably not African, possibly European, but considering the relative advancement and geological position of the European and African species, more probably of Asiatic origin. We may suppose that from a diffusion center in Northern Asia early stages in the evolution of the phylum reached Europe in the Middle and Upper Eocene. More advanced forms migrated to Africa near the end of the Eocene, and to Europe and North America at the beginning of the Oligocene. In Europe they became somewhat modified but disappeared with the close of the Middle Oligocene. In North America they evolved longer upon parallel lines, *Arretotherium* being probably the final stage of their evolution. They presumably became extinct in northern Asia early in the Oligocene (since none of them accompany any later migration from this center) but spread southward to India, where their survivors and modified descendants (*Merycopotamus*) existed until the late Miocene.

The latest member of the phylum, *Merycopotamus,* is distinguished by the loss of the fifth cusp on the molars, and the assumption of a hippopotamoid type of skull, with wide flaring muzzle and powerful canines. *Arretotherium* in North America represents a corresponding but less specialized type. It has lost the fifth cusp on the molars but is otherwise very like *Ancodon* and especially *A. leptodus,* in which the fifth cusp was apparently present, although the wear of the teeth in the type specimen prevents me from determining whether it was well developed or not. Mr. Douglass regards the beds in which *Arretotherium* was found as Oligocene, but they may quite as well be Lower Miocene. The only accompanying fossils were the back of the skull of a rhinoceros, referred to *Cœnopus,* and the lower jaw of a species of *Steneofiber, S. hesperus* Douglass. *Cœnopus* ranges from

Lower Oligocene to Lower Miocene or later, *Steneofiber* from Upper Oligocene to Lower Miocene (doubtfully later). *S. hesperus* is closely allied to the Lower Miocene species, especially to *S. montanus* Scott.

3. Comparative Measurements of the American Species.

I append a table of comparative measurements taken from the following specimens:

A. americanus Leidy.
- (1) Type (Phila. Acad. Coll.). Measurements taken from Leidy's figures.
- (2) No. 11867 Am. Mus. Coll., a finely preserved skull from the Lower Titanotherium Beds, found by H. F. Wells.

A. rostratus Scott.
- (1) Type (Princeton Mus. Coll.). Measurements given by Scott, 1894.
- (2) No. 575 Am. Mus. Coll., incomplete skull figured by Osborn and Wortman as *A. americanus* but referred by Scott to *A. rostratus*.

A. brachyrhynchus Osborn and Wortman.
- (1) Type, No. 582, Am. Mus. Coll., skull lacking premaxillæ and canines.
- (2) No. 10650, Princeton Coll., skull, jaws and part of skeleton (measurements from Scott, 1894).
- (3) No. 583 Am. Mus. Coll., lower jaws.

A series of skulls of *A. brachyrhynchus* in the American Museum collection from the same horizon and locality as the type, agree fairly well in measurements of teeth, but show a wide range of variation in size and robustness of skull. Corresponding variability is observed in skulls of modern pigs, and it is probably not of specific value.

A. leptodus sp. nov. supra.
- (1) Type, No. 13005 Am. Mus. Coll., described above.

	A. americanus.		A. rostratus.		A. brachyrhynchus.			A. leptodus.
	Type.	A. M. No. 11867	Type.	A. M. No. 575	Type.	Princeton No. 10650	A. M. No. 583	Type.
Skull, extreme length	—	493	451	—	—	338	—	323[1]
Upper dentition, i^1–m^3	—	303	—	242	205[1]	—	—	201[1]
" cheek teeth p^1–m^3	—	154	120	124	134	125	—	121
" true molars m^{1-3}	76	81	71	76	73	63	—	66

[1] Premaxilla and incisors estimated.

	A. americanus. Type.	A. americanus. A. M. No. 11867	A. rostratus. Type.	A. rostratus. A. M. No. 575	A. brachyrhynchus. Type.	A. brachyrhynchus. Princeton No. 10650	A. brachyrhynchus. A. M. No. 583	A. leptodus. Type.
Post canine diastema	—	70	90	66	19	—	—	23
P^3, transverse diameter	18	17	—	—	17	—	—	14
" antero-posterior diam.	18	17	—	—	17	—	—	16
M^3, transverse diameter	31.5	33	—	30	30	—	—	29
Lower jaw, total length	—	—	—	—	—	302	320[2]	293[2]
" dentition i_1–m_3	—	—	—	—	—	—	203[2]	200[2]
" cheek teeth, p_2–m_3	—	—	132	—	—	—	126	123
" true molars m_{1-3}	—	—	82	—	—	78	78	74
Diastema behind c_1	—	—	22	—	—	—	18	10
" " p_1	—	—	55	—	—	—	19	20
P_3, transverse diameter	—	—	—	—	—	—	9	8
" anteroposterior diam.	—	—	—	—	—	—	17	16
M_3, transverse diameter	17.5	—	—	—	—	—	18	16
" anteroposterior diam.	—	—	—	—	—	—	36	36
" transv. diam. of heel	—	—	—	—	—	—	9	12

4. Synonymy of the Genus and of the American Species.

Hyopotamus Owen 1848, and *Ancodon* Pomel 1847, are the names in common use. The former is preoccupied by *Hyopotamus* Kaup 1844, a genus of supposed Hippopotamidæ not now recognized. Both names are probably antedated by *Bothriodon* Aymard 1846 (see Bush, 1903, Andrews, 1906). As there appears from Dr. Andrews's statement to be still much uncertainty as to the date of Aymard's genus, I follow his example in retaining *Ancodon* for the present. Besides the four American species which have been considered valid, three others have been proposed by Professor Marsh.

Hyopotamus deflectus Marsh 1890, is regarded by Scott as a synonym of *Ancodon americanus*, and comes from the same horizon and locality. Dr. Hay in his 'Catalogue' has indorsed this opinion. I have not seen the type, an incomplete skull in the Museum of Yale University.

Heptacodon armatus Marsh 1894, subsequently made the type of *Elomeryx* Marsh 1894, is based upon a worn upper molar of an Anthracotheriid from the Protoceras Beds. I formerly (1899) placed it along with the type species of *Heptacodon* (*H. curtus* Marsh) in the genus *Anthracotherium*. A more careful study of Marsh's figure of the type specimen convinces me

[2] Incisors estimated.

that it is more probably a species of *Ancodon*. It is quite likely the same as *A. brachyrhynchus,* which it antedates, but it is at present indeterminate and I set it aside as such.

Elomeryx mitis Marsh 1894, also from the Protoceras beds, is based upon three worn upper molars which appear to belong to the milk dentition. It is referable to *Ancodon* and is quite likely identical with *A. brachyrhynchus,* which it antedates by a few days, but it is also, in my opinion, specifically indeterminate, and may be set aside as such.

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56.57,7(78.8)

Article II.— FOSSIL DIPTERA FROM FLORISSANT, COLORADO.

By T. D. A. Cockerell.

Plate I.

Syrphus willistoni sp. n. (Syrphidæ.)

Length about 10 mm.; wings clear, with reddish-brown veins; the head and thorax were apparently black; the abdomen pallid, with three broad transverse, and a narrower median longitudinal, bands, which as preserved are pale reddish-brown, somewhat iridescent, with green tints. This is a typical *Syrphus*, of the group in which the yellow areas on the first three abdominal segments are all large, much broader than the dark bands, and wholly interrupted in the middle. The abdomen is comparatively broad (breadth about 3 mm.), the general build of the insect being much as in *S. arcuatus*, although the large quadrate pale areas on segments 2 and 3 are very unlike the arched bands of *arcuatus*. Professor Melander, to whom I submitted a photograph, remarks on the close resemblance to the European *S. vittiger* Zett.

The venation is like that of *S. arcuatus* (specimen from Beulah, New Mexico, compared) with the following exceptions:—

(1) The anterior cross-vein in *willistoni* is not so far from the apex of the second basal cell.

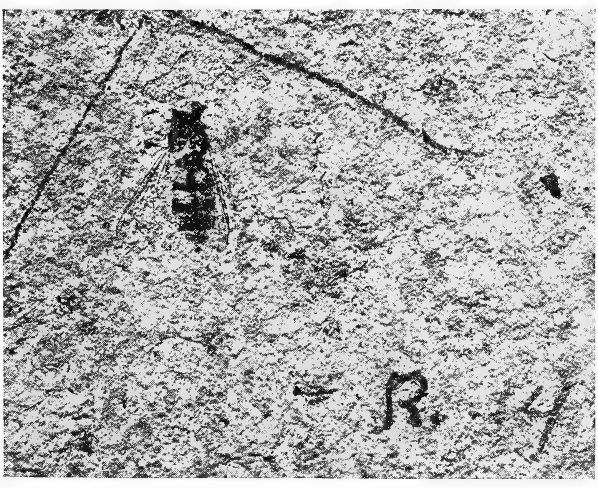


Fig. 1. Type of *Syrphus willistoni*. $\frac{2}{1}$.

(2) The second vein (R_{2+3}) is straighter,— less distinctly arched.

(3) The third vein is much straighter; thus it results that the first submarginal cell is not narrowed in the subapical region, as it is in *S. arcuatus*.

Hab.— Miocene shales at Florissant, Station 14 (*S. A. Rohwer*, 1907); also two from Sta. 13 (*W. P. Cockerell*). I showed a lantern slide of this species to Dr. Williston, who confirmed the opinion that it was a strictly typical *Syrphus.*

Psilocephala scudderi sp. n. (Therevidæ.)

Plate I, Fig. 3.

Length (exclusive of antennæ) about 10½ mm.; wing about 6. Head, thorax and legs black; abdomen very dark red-brown, its width near base about 2 mm.; wings dark fuliginous, the apical half distinctly darker than the basal; face apparently bare, certainly not conspicuously hairy; antennæ a little over 1 mm. long, stout, with a long third joint; venation normal, the fourth posterior cell closed. The costa and radius (vein 1) are strong, black and bristly; the other veins weak and not very easy to see. Vein 1 is very distinctly bent near the end of its basal third, and the extremely weak auxiliary vein follows it closely, as in Williston's figure in N. Am. Dipt., 3rd ed., p. 207, instead of diverging as in *P. agilis* Meunier from amber. The second vein, as in Williston's figure, turns upward at the end; in *P. agilis* it is merely faintly curved. The second submarginal cell is distinctly longer, and therefore narrower in proportion than in Williston's figure; its length is barely short of 2 mm. The anterior cross-vein is about the middle of the discal cell, certainly not beyond the middle, as it is in Williston's figure (in *P. agilis* it is a short distance before the middle); the discal cell is conspicuously longer and narrower than in Williston's figure, herein agreeing better with *P. agilis.* The fuliginous wings are like those of *P. johnsoni* Coquillett, from Florida.

Hab.— Miocene shales of Florissant, Station 14. (1907.) Scudder indicated the presence of Therevidæ in the Florissant shales, but did not describe any.

Megacosmus gen. nov. (Bombyliidæ.)

Large, with ample wings and an elongate abdomen, the general build suggestive of Leptidæ; body and legs with comparatively little hair. In Williston's table (N. A. Dipt., 3rd Ed.) it runs to *Paracosmus,* but it is much larger than the species of that genus or *Desmatomyia,* and the end of the second vein curves backwards to meet the costa at an angle even a little more obtuse than that seen in *Pantarbes.* Two submarginal cells and four posterior, all these, as well as the anal, open; anterior cross vein much beyond middle of discal cell; separation of second and third veins basad of base of discal cell; discal cell elongate, with its side on the third posterior cell long, about one fourth longer than its side on fourth cell (the proportions not very different from those in *Bombylius*); upper branch of third vein curving upwards, to meet the costa at an obtuse (inner) angle.

A related genus is *Alepidophora* Ckll. ined., also from the Florissant shales. The following table exhibits the main differences:—

Megacosmus mirandus.	*Alepidophora pealei.*
Length of wing 13 mm.	Length of wing 6½ mm.
Basal part of upper branch of third vein regularly curved, with no rudiment of cross-vein.	Basal part of upper branch of third vein bent at a right angle, with a rudiment of the cross-vein running basad.
Abdominal somites much longer in proportion to their breadth.	
First posterior cell more widely open.	

It seems that during Miocene times the nearly naked, long-bodied Bombyliidæ were varied and probably numerous. I believe that the short hairy types may have invaded the country from Eurasia, with the result that the long-bodied genera are now represented by few species, and these rare, in remote and peripheral parts of America. The comparative prosperity of *Systropus*, and its wide distribution, may be due to its imitation of the fossorial wasps.

Megacosmus mirandus sp. nov.

Plate I, Fig. 1.

♂. Length about 17 mm.; wing 13 mm.; width of thorax 4 mm.; of abdomen near base $4\frac{1}{4}$ mm.; length of third abdominal somite $1\frac{1}{2}$ mm.; breadth (depth) of wing 4 mm. Head missing in type; thorax and legs black not hairy, although with the compound microscope the tibiæ are seen to be quite thickly covered with appressed coarse hairs, about 150 μ long, while the femora have some short outstanding hairs beneath. Abdomen elongate, dark red-brown, the sutures pallid; at first sight, the abdomen seems practically hairless, but a strong lens or the compound microscope reveals coarse black bristles along the hind-marginal region of the segments, especially at the sides; on the hind margin of the sixth segment these are very dense, though short. Genitalia apparently large and much as described in *Paracosmus*, though I am not able to make out the details. Wings long and ample, a rather dilute fuliginous, with pale nervures (in *Alepidophora* they are hyaline, with dark nervures). The following wing-measurements are in micromillimeters:—

Distance on costa from end of second vein to end of upper branch of third	2210.
Distance from separation of second and third veins to level of basal end of discal cell	935.
Upper side of discal cell anterior to anterior cross-vein	3910.
Upper side of discal cell posterior to anterior cross-vein	1410.
Discal cell on second posterior	612.
" " " third posterior (allowing for curve)	2720.
Width of first posterior cell at apex	442.
" " anal cell at apex	340.
Discal cell on second basal	765.
Width of anal cell at level of basal corner of fourth posterior	578.

The fourth posterior here is morphologically fourth and fifth combined.

The outer angle made by the second vein with the costa is not over 50°, that made by the upper branch of the third vein is about 65° or 70°.

Hab.— Miocene shales of Florissant, Sta. 14 (*W. P. Cockerell*, 1907).

Sciomyza florissantensis sp. nov. (Sciomyzidæ.)

Plate I, Fig. 2.

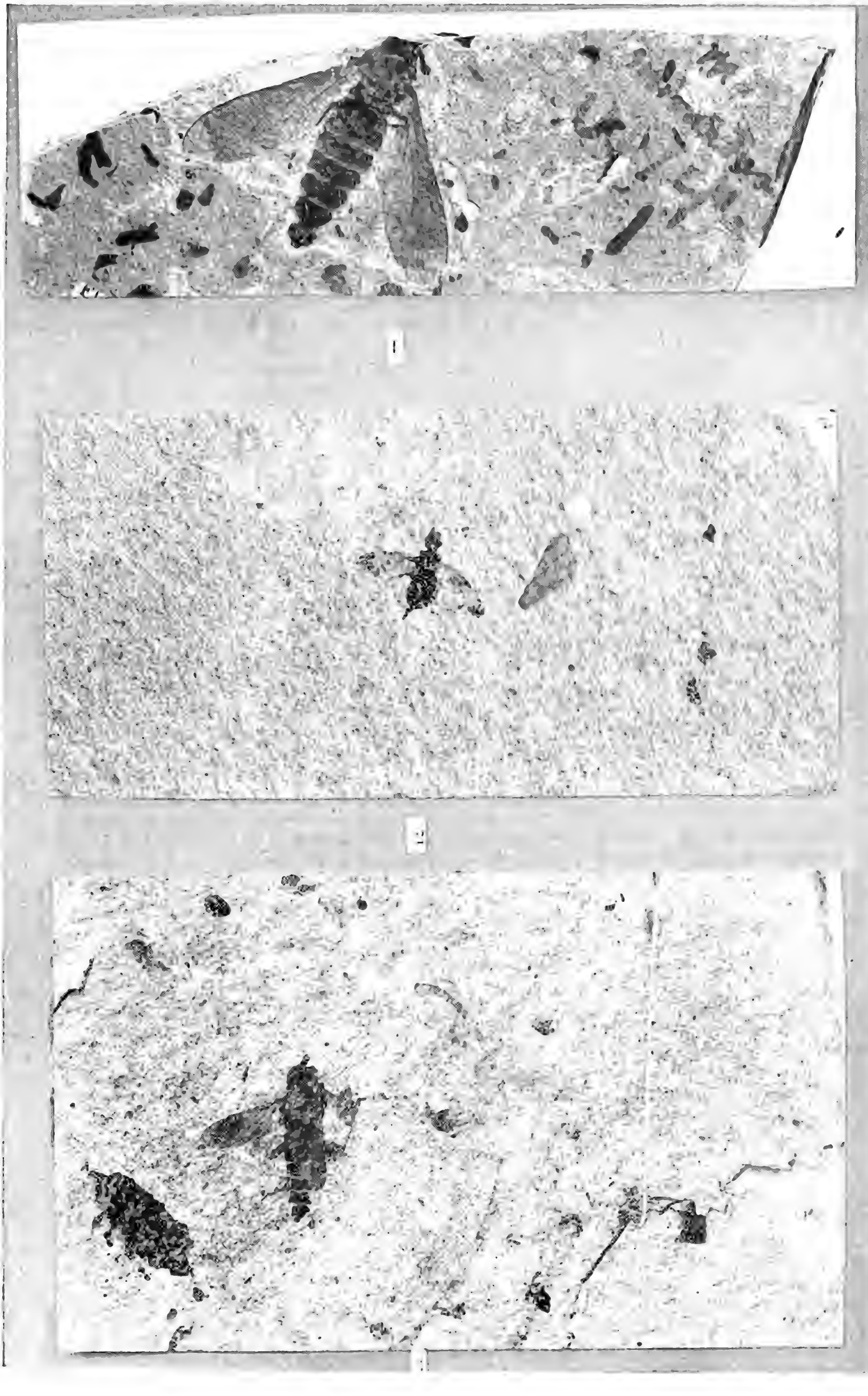
♀. Length 5 mm.; wing $4\frac{2}{3}$ mm.; proportions ordinary, the abdomen oval; ovipositor protruding somewhat over 1 mm. (not counted in measuring length); head and thorax dull dark reddish-brown; abdomen shining, a little redder; legs dark; wings hyaline with large fuscous clouds, veins fuscous. The wing markings

are as follows: apex broadly fuscous, the dark cloud extending a short distance along costa; apical margins of first basal and discal cells broadly clouded (as in living species); middle of costa broadly clouded, the dark color ending about at the end of first vein; this costal extends broadly downwards and obliquely basad. In the living *Tetanocera clara* the same markings may be seen, in modified form; thus in the *Tetanocera* the costal portion of the apical cloud has become more prominent, and separated from the apical portion; while the mid-costal cloud, so large in the fossil, has become reduced to a small spot.

The costa bears minute black bristles; the first vein is bare. The end of the first vein is more apicad than usual; thus it is about 2720 μ from the base of the wing, but only 1700 μ from the end of the second vein. The end of the second vein is straight — not at all turned upwards. The anal cell is quite normal, its apical side truncate, bulging. The first basal cell extends 1140 μ beyond the second.

Hab.— Florissant, in the Miocene shales, Station 13 (*W. P. Cockerell,* 1907). From the heavily spotted wings, this looks like an Ortalid.

The types of all the above species are in the American Museum of Natural History.



Fossil Insects, Florissant, Col.

1. *Megacosmus mirandus*, sp. nov.
2. *Sciomyza florissantensis*, sp. nov.
3. *Psilocephala scudderi*, sp. nov.

56.(1181:78.7)

Article III.— FAUNAL HORIZONS OF THE WASHAKIE FORMATION OF SOUTHERN WYOMING.

By Walter Granger.

Plates II–VI.

Introduction.

Dr. W. J. Sinclair has recently shown [1] that the rocks of the Washakie beds, like those of the Bridger, are formed entirely of volcanic material, but that the nature of this material differs markedly from that of the Bridger sediments. The older idea that both formations may have been deposited in different parts of the same lake has long been abandoned and the theory that the Washakie was deposited separately and at a somewhat later time has gradually taken its place. The chief evidence for considering the Washakie as more recent than the Bridger has been palæontological. Compared with the Bridger and Uinta beds, fossils in the Washakie are not abundant, but as material has gradually accumulated, through the efforts of Cope and Marsh, and of parties from Princeton University and the American Museum, it has finally become evident that the Washakie fauna represents two distinct facies; one closely related to that of the upper Bridger, the other to that of the Uinta. Recent studies on the Titanotheres by Professor Osborn have afforded much evidence on this point. In the summer of 1906 the writer, in company with Professor Osborn, examined thoroughly the northern part of the Washakie beds, where by far the larger part of the fossils have been obtained, a special effort was then made to determine the levels of all important specimens which have been found in the beds, for the purpose of outlining the faunal horizons. In this short article, written at the suggestion of Professor Osborn, an attempt is made to indicate these horizons and to present as clearly as possible the distinctive mammalian fauna of each.

Historical.

The first use of the name Washakie (Washakee) as applying to a geological group is in Hayden's Preliminary Field Report, 1869,[2] and appears to include, aside from what is now termed Washakie, strata belonging to the

[1] Paper entitled "The Washakie, A Volcanic Ash Formation" read before the Am. Soc. Vert. Palae., at New Haven. Dec., 1907.

[2] F. V. Hayden, 1869; Prelim. Field Report, U. S. Geol. Surv. Col. and N. Mex., p. 90.

Green River shales and to the Wasatch formation. Hayden's reference is as follows: "From Creston to Bitter Creek there are a series of purely fresh-water beds, with some beds of impure lignite, with vast quantities of fossils belonging to the genera Unio, Melania, Vivipara, Helix, etc. This group I regard as middle tertiary, and the strata are very nearly horizontal. I have regarded these beds as separated from the lower tertiary or true lignite group, and have designated them by the name of the Washakie group." This description refers more particularly to the Tertiary beds that are exposed along the Union Pacific Railway, but in his Fourth Annual Report for 1870,[1] Hayden describes the actual Washakie exposures along the Overland Stage Trail as follows: "Between La Clede and Barrel Springs the strata are very nearly horizontal. The surface is less rugged; still to the south of the road are high, rather abrupt ridges, and in the distance are quite pointed ridges three hundred feet high, composed of the somber, hard, indurated, rusty, arenaceous clays which characterize the Bridger group. Indeed, from its form and style of weathering, and the color of its sediments, it could not be distinguished from the high ridges of the Bridger beds west of our road from Henry's Fork to Green River Station. Although I have hitherto regarded the group of beds which I have denominated the 'Washakie group,' as separated from those of Green River and to the westward, yet I am now inclined to believe that the upper series is either an extension eastward of the Bridger group or synchronous with it. Fragments of turtles and other vertebrate remains are not uncommon."

Immediately following the discovery of vertebrate fossils in these Washakie bad lands both Professor Marsh and Professor Cope made collecting expeditions into the basin and the former maintained collectors there for several seasons. Little has been published by Marsh concerning the topography or geology of the basin but Cope has given a very good account of his explorations in this region, in 1872,[2] especially in the vicinity of Haystack Mountain, in the northern part of the basin, where he found the splendid type skull of *Eobasileus* (*Loxolophodon*) *cornutus*, and his somewhat lengthy account of the exact locality in which the skull was found serves to locate the specimens as coming from near the top of the formation.

In 1877 King in his systematic Geology of the Fortieth Parallel Survey gives the first extended description of the Tertiary deposit of the Washakie Basin. The Washakie, or Bridger group of the Washakie Basin, as he terms it, is here described, and mapped in the atlas accompanying the report, as occupying the center of the basin and resting probably unconformably

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[1] Preliminary Report of the U. S. Geol. Surv. of Wyo. and Portions of Contiguous Terrs., 1871, p. 73.

[2] Penn Monthly Magazine, August, 1873.

upon the Green River shales and entirely surrounded by exposures of the same; the Green River shales in turn resting upon the Vermillion Creek beds (Wasatch) which are exposed in a nearly continuous circle outside. King, while believing that the sediments of the Bridger group in the Washakie and Bridger basins were of nearly contemporaneous deposition, expresses doubt as to whether they were laid down in one lake or in separate smaller lakes, but rather inclines to the latter theory, thinking it improbable that all sediment connecting the two areas should have been removed by erosion.

Professor Osborn in 1881 [1] favored the separate deposition theory, pointing out not only a considerable dissimilarity between the sediments of the two basins and their mode of weathering, but in the fauna as well, and assumed that there may have been some difference in the date of their deposition. The Princeton Scientific Expedition which visited the Washakie Basin in 1878, and of which Professor Osborn was a member, was fortunate in securing an extensive and important collection, especially from the upper horizon in which mammalian remains are particularly scarce. Accompanying the memoir by Professor Osborn, cited above, is a Stratigraphic Report on the Washakie beds by Professor John B. McMaster, the leader of the Expedition. In this report the strata are described in detail, several cross-sections of the exposures are figured and, most important of all, the levels of many of the fossils found by the party are given. The thickness of the sediments described is given as about 700 feet, but there is an error in the joining of two of his sections taken at different localities; one section partly duplicating the other, instead of their forming one continuous section as he states.

Prof. Scott, 1889,[2] in reviewing the faunæ of the Bridger, Washakie and Uinta beds, points out the differences between the fauna of the Washakie and that of the Bridger and states that "where the fauna of the Washakie basin departs from that of the Bridger basin, it does so in the way of resemblance to the Uinta," and concludes, therefore, that the Washakie beds represent a somewhat later date of deposition than the Bridger.

Since the Princeton Expedition there have been three collecting expeditions made into the basin by the American Museum. The first, in 1893, under Dr. J. L. Wortman, discovered a rich field in the lower part of the formation in what was entered on the field records as the "Lower Brown Sandstone." This stratum yielded numerous skulls and skeletal parts of Uintatheres and Titanotheres. In 1895, Dr. Wortman conducted the

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[1] Cont. from E. M. Museum of Geol. and Archæ. of the College of N. J., Vol. I, No. I, p. 13.

[2] Am. Phil. Soc. Trans., 1889, Vol. XVI, Pt. iii, pp. 462–470.

second expedition into the basin, when the party discovered an outcrop of this same Brown Sandstone in the extreme southern part of the basin, in the vicinity of the Cherokee Trail, which proved rich in the forms found to the north in the same layer. The third expedition, in charge of the writer, in 1906, examined quite thoroughly the entire northern half of the exposures, making a special effort to collect fossils from the upper horizon, collecting a complete series of the rocks and making stratigraphic notes.

The observations made on the expedition together with the results previously obtained may now be set forth.

Topography and Geology.

The Washakie Formation occupies a somewhat circular area of over three hundred square miles; the northern border extends to within twenty miles of the Union Pacific Railroad between the stations of Red Desert and Bitter Creek, and nearly the entire area lies between the old Overland Stage Trail, on the north, and the Cherokee Trail to the south: it is separated from the nearest exposures of the Bridger beds to the west by a distance of about fifty miles. The Overland Trail, five miles east of La Clede Station, passes up over the lowest bench of the formation near its northern limit and after running along the bench for five miles turns down again at Tadpole station into the underlying beds of the Green River group.

The limits of the formation are outlined, except to the southwest by a prominent bench which is capped with a conspicuous layer of hard, rusty, brown sandstone. The face of this bench, which weathers nearly vertically, is nearly 100 feet high along its northern border but to the southeast and southwest it gradually diminishes in height until it finally merges into the plain and the sandstone layer is lost beneath the growth of sage brush. A few miles south of the northern part of this bench there arises abruptly from the plain a long ridge of bad lands, partly covered with cedars, and reaching an elevation above the plain in places of 400 feet. The ridge extends in an east and west direction for six miles. To the east the elevation terminates suddenly in a partly isolated conical butte; to the west an obtuse angle is formed and the elevation gradually drops away to the southwest and four or five miles distant is lost in the plain. The entire ridge is known locally as Haystack Mountain and on the field records of most of the collecting parties it appears as such. Professor Cope, though, in his description of the region apparently uses the name only for the conical butte at the eastern end; the rest he calls "Mammoth Buttes."

Haystack Mountain forms the northern border of an extensive semi-

circular central basin, the rim of which reaches from the western end of Haystack Mountain southward almost to the southern limit of the formation.

This basin is open to the eastward and is drained by Sand Creek. The creek is nothing more than a dry sand arroyo except during times of rain or melting snow. From the edge of the rim the sage brush plain falls away abruptly giving the basin something the appearance of a gigantic crater. McMaster aptly likened it to a great arena. The floor of the basin is rather level and regular, being broken only by a few low tables and buttes which have, by reason of hard sandstone cappings, withstood the erosion, but the sides, which are cut down below the plain from two to four hundred feet, present one of the most extraordinary examples of bad land topography to be found in our western Tertiary beds. The innumerable, deep, vertical-walled cañons, the great variety of architectural forms and the brilliant coloring, especially just after a rain, make a magnificent spectacle.

Between the rim of this basin and the sandstone ledge, mentioned as being at the base of and outlining the formation, a distance of from one to five miles, the surface is rolling prairie covered with a dense growth of sage brush, broken here and there by low benches of sandstone and bad land 'pockets,' none of any great extent. To the north and west of Haystack Mountain the region is drained by the upper reaches of Bitter Creek; to the southwest and running along nearly parallel with the rim of the central basin is Shell Creek, a tributary of Vermillion Creek. These creeks are usually without running water during the summer. Two springs of importance occur in the northern part of the region. The first, called La Clede spring, flows from the banks of Bitter Creek one mile below the La Clede Station and eight miles from the northwest point of Haystack Mountain. The other is in the open prairie twelve miles southwest of La Clede and is known as Kinney Spring. The drainage here is into Shell Creek. It is five miles directly east from Kinney Spring to the edge of the central basin. The bad lands at this part of the rim are known, because of their peculiar form of weathering, as "Adobe Town."

The entire thickness of the Washakie beds, measured from the brown sandstone at the Overland Trail to the summit of Haystack Mountain, is approximately 650 feet; below the brown sandstone there is exposed in the northern part of the basin a hundred feet of gray sandy shales which, so far as a careful examination has shown, are unfossiliferous. On the other hand, the overlying brown sandstone is the richest in mammalian remains of any of the Washakie strata, and in layers immediately above the Sandstone bones are found in some abundance. There seems to be no unconformity between the sandstone and the underlying shales. Accumulations of soil obscure contact between these shales and beds of undoubted Green River

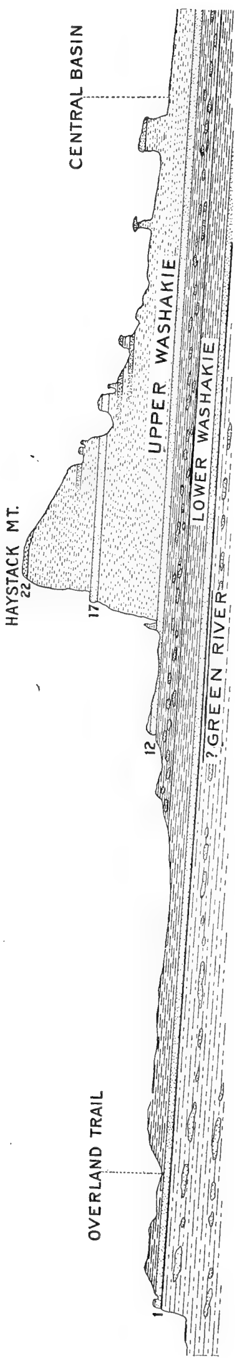

Fig. 1. Cross section through the northern part of the Washakie formation; looking east. A horizontal distance of about five miles is represented. The numbers correspond with those of the section on p. 19.

age, and whether they should be included in the Washakie or not the writer is in doubt. King has recorded a difference of dip of several degrees between the Green River beds and the nearest definite Washakie beds in the southern part of the basin.

Throughout the greater part of the formation the beds show a decided dip, and always toward the center of the basin. In the northern part the dip averages 6°, and the lowermost strata pass under the base of Haystack Mountain and under the central basin at a considerable depth, although the floor of the center of the basin is lower than the brown sandstone outcrop to the north and west. This has led to some confusion regarding the levels of certain important specimens, such as the skulls of *Achænedon* and *Amynodon* collected by the Princeton party and which were recorded as coming from the lower levels because they were found at the base of the bad lands inside the central basin. This level if traced out carefully to the north side of Haystack Mountain would be found well up on the side of the mountain. In the roughly sketched section (Fig. 1) the relation of the upper and lower horizons to the Mountain, plain and central basin are shown. In Professor McMaster's sections that numbered 2 was taken inside the basin and is therefore duplicated by his section number 1 which was taken from the summit of Haystack Mountain down to a bench well out in the plain toward the basal sandstone.

The section given below was taken at the east end of Haystack Mountain, because a more perfect exposure exists there, especially of the lower beds. The Lower Brown Sandstone here approaches to within a mile of the base of the mountain, and not more than half of the intervening area is

covered with soil or vegetation. The term 'sandstone' is applied to those strata which have been generally termed sandstones. According to Dr. Sinclair, quartz does not enter, in any appreciable quantity, into the structure of Washakie rocks.[1]

Section of the Washakie beds taken from the Summit of Haystack Mountain, at the east end, down to the Basal Sandstone at Tadpole Stage Station on the Overland Trail.

Top.

22. Very coarse and very hard greenish sandstone, weathering brown . 15 feet. Not fossiliferous. This layer breaks up into enormous blocks weighing many tons each which are found strewn over the side of the mountain.
21. Gray, green, salmon colored and purple sandstones and sandy shales with a few thin bands of clay shales . . . . 150 feet. To the westward the salmon tints give way to pink. From Cope's description it was apparently in this division and a few miles to the west that he found the skull of *Eobasileus cornutus*.
20. Light gray (nearly white) coarse sandstone, cross bedded and of only local occurrence . . . . 20 feet.
19. Gray and brown sandy shale and loosely compacted gray sandstone. 45 feet. On approximately this level and in very light gray sandstone, on the northwestern face of the mountain, was found the skull of *Dolichorhinus hyognathus*.
18. Light brown clay shale . . . . 8 feet.
17. Very coarse loosely packed gray sandstone, containing pebbles and clay pellets in layers . . . . 15 feet. Except in the uppermost and lowermost strata this is the most constant layer found in these beds. To the westward it is of a pale yellowish green color and can be traced around the point of the mountain and then to the southwest until it is lost under the plain. The type skull of *Metarhinus earlei* and the skull of an undescribed species of *Limnocyon* are from this stratum.
16. Gray sandy shale, with one thin band of gray sandstone . . . . 5 feet.
15. Gray, greenish and yellowish sandy shales and soft sandstones . . 50 feet. Represented to the westward chiefly by light gray and pink sandstone.
14. Green and blue-gray sandstone, weathering vertically . . . . . . 15 feet.
13. Greenish gray sandy shale and soft sandstone . . . . 50 feet. The disintegrated material on the surface of this stratum is a foot or more deep.
12. Hard, fine, green and greenish gray sandstone . . . . 2 feet.
11. Light gray sandy shale, weathering white . . . . 4 feet. This was a rather conspicuous stratum and quite constant at the east end of the mountain. To the west the stratum passes under the plain.

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[1] The sandstones have been classified by Dr. Sinclair as Tuff Sandstone and Feldspar conglomerate.

10.	Gray and greenish gray sandy shales, a harder layer at the top forming a bench	15 feet.
9.	Flinty hard greenish sandstone A bench of considerable extent is formed by this layer.	2 feet.
8.	Gray sandy shale, with two layers of nodular sandstone	35 feet.
7.	Hard, brittle, shaly sandstone, weathering brown	1 foot.
6.	Gray and greenish sandy shale alternating with gray, brown-weathering sandstone, the lower twenty feet having thin bands of mottled clay weathering red	60 feet.
5.	Area of one half mile covered with sage brush; represented at other localities by numerous layers of gray nodular sandstones (weathering rusty color) interstratified with gray sandy shales. Fossils fairly abundant . . . approx.	75 feet.
4.	Gray sandy shale	10 feet.
3.	Brown sandstone (local)	10 feet.
2.	Gray sandstone, bluish and gray sandy shale and hard fissile shale The fissile shales are pale green in places, particularly near La Clede Station and toward the Kinney Spring. Remains of the smaller mammals are rather abundant in the division.	40 feet.
1.	Hard sandstone, weathering rusty brown, nodular in places and very uneven as to thickness. In some places it consists of several thin layers separated by sandy shale, in others of a single solid stratum. This is the Lower Brown Sandstone of the Amer. Mus. Expedition of 1893 and 1895. It extends in a nearly continuous rim around the Basin and marks the limits of the Washakie formation. Rich in Mammalian remains, especially of Uintatheres and Titanotheres. Average thickness	15 feet.
Total thickness		642 feet.

There is no evidence of a break in sedimentation from the base to the summit of the Washakie series but the beds seem to fall into two horizons; the lower 250 feet and the upper 400 feet. Divided in this manner, the upper horizon is characterized by coarse white, pink and salmon-colored sandstones and by the extremely coarse green sandstones, or feldspar conglomerates; the lower horizon is characterized by the rusty brown nodular sandstones. The fine green tuff-sandstones occur in both horizons. In general appearance the lower beds are dull and somber while the upper ones are bright and often highly colored. Stratum No. 11, a nearly white sandy shale, was selected, for the purpose of field labelling, as dividing the lower from the upper beds, which were termed respectively horizons A and B. Fossils found immediately below stratum No. 11 (*Manteoceras* and *Sinopa*) pertain to that phase of the fauna which more nearly resembles the fauna of the Bridger, while the first fossils found, about 60 feet above the datum plane, pertain to the Uinta phase. The layer was selected because it was continuous and easily recognized. Most of the subdivisions recognized in

the section given above do not exist, with any uniformity of character, over

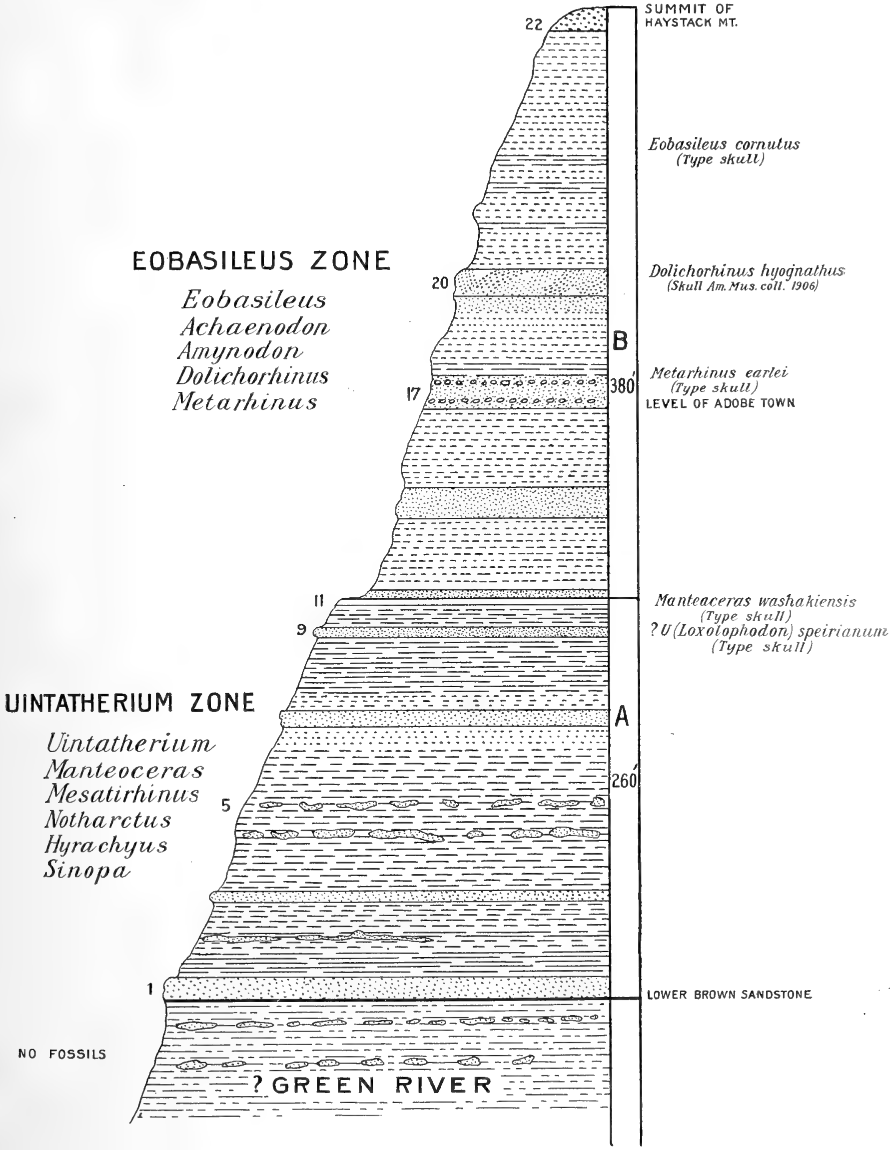


Fig. 2. Columnar section of the Washakie beds.

any great area. It is possible that strata Nos. 12 and 13 (55 feet) should be included in the lower horizon.

Fauna.

Conforming with the petrographic differences between the upper and lower horizons is a marked difference in their faunæ, representing, nearly, the difference between the fauna of the Upper Bridger and the Lower Uinta. The following table, compiled with the assistance of Dr. W. D. Matthew, includes the genera known to occur in the Washakie with the horizons of their occurrence given wherever known.

Occurrence of Washakie Mammalian Genera.

		Washakie		Uinta
	Bridger	Hor. A.	Hor. B.	Hor's. A. & B.
Hemiacodon	*	*		
Notharctus	*	*		
Hyopsodus	*	*	?*	*
Miacis	*	*		
Thinocyon	*	*		
Sinopa	*	*		
Synoplotherium (incl. Dromocyon)	*	*		
Patriofelis	*	*		
Harpagolestes	*		*	*
Limnocyon	*		*	
Uintatherium	*	*		
Eobasileus			*	?*
Amynodon			*	*
Hyrachyus	*	*	?*	
Triplopus			?*	
"Triplopus" amarorum [1]			?*	*
Desmatotherium		?*		
Dilophodon		*		
Palæosyops	*	*		
Manteoceras	*	*		
Telmatherium	*	*		
Mesatirhinus	*	*		
Dolichorhinus			*	*
Metarhinus			*	*
Homacodon	*	*		
Achænodon			*	*
(?) Protylopus			*	*
Paramys	*	*	*	*

[1] The type of *Triplopus amarorum* Cope is from the Washakie, level uncertain. It does not belong to this genus as defined by the generic type *T. cubitalis* Cope.

From the above table it will be seen that the genera of the Lower Washakie are, almost without exception, found in the Bridger, and, it may be added, are represented by species closely allied to Upper Bridger species and in some cases identical with them. None of them excepting *Hyopsodus* and *Paramys* pass through to the Uinta.

The genera of the Upper Washakie are mostly distinct from those of the Lower Washakie or Bridger and are represented in the lower horizons of the Uinta by closely allied or identical species. Two Bridger genera of Carnivora, *Harpagolestes* and *Limnocyon,* are represented in the Upper Washakie and not in the Lower, but the species differ widely from those of the older horizon.

The entire absence from the Washakie of such a group as the Hyracotheres can be accounted for only by the fact that fossils, and this is true especially of the smaller forms, are comparatively rare there; that the animals existed there at that time but that their remains have not yet been discovered.

So far as discoveries have gone, however, they tend to show that faunally the Lower Washakie corresponds with the Bridger C and D (Middle Eocene) and the Upper Washakie with the Uinta A and B (Upper Eocene).

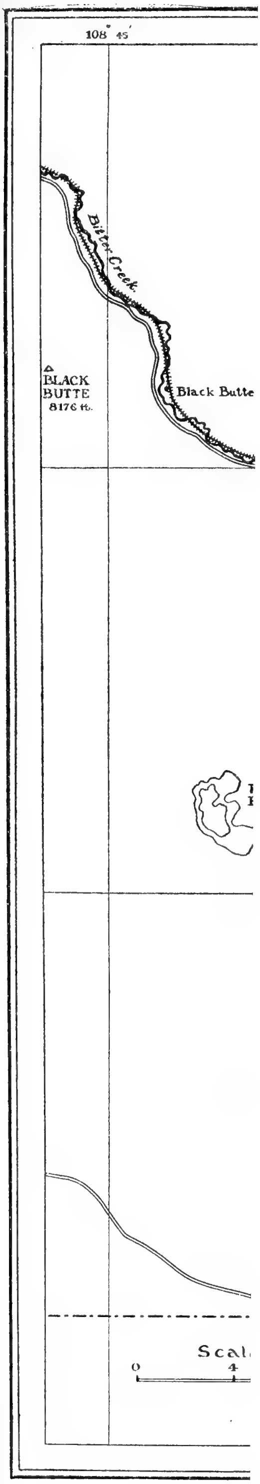


Fig. 3. Sk

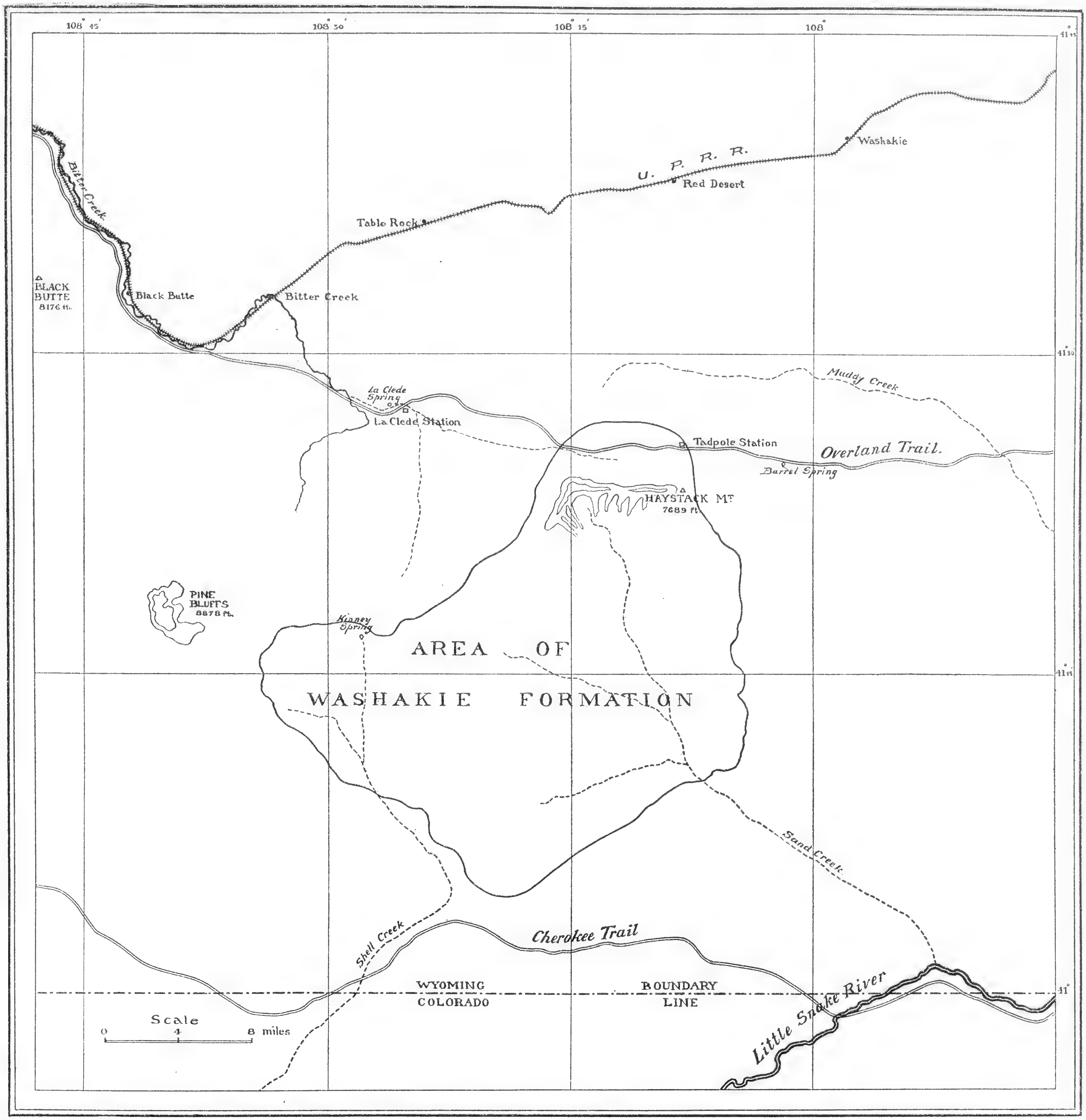
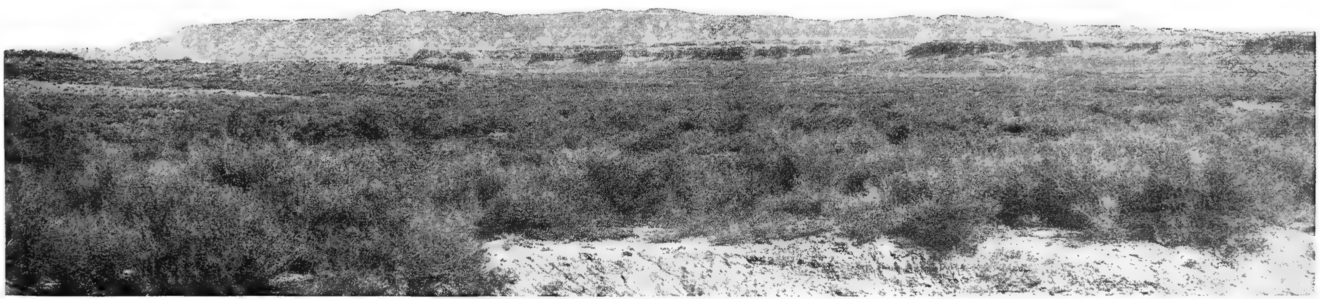
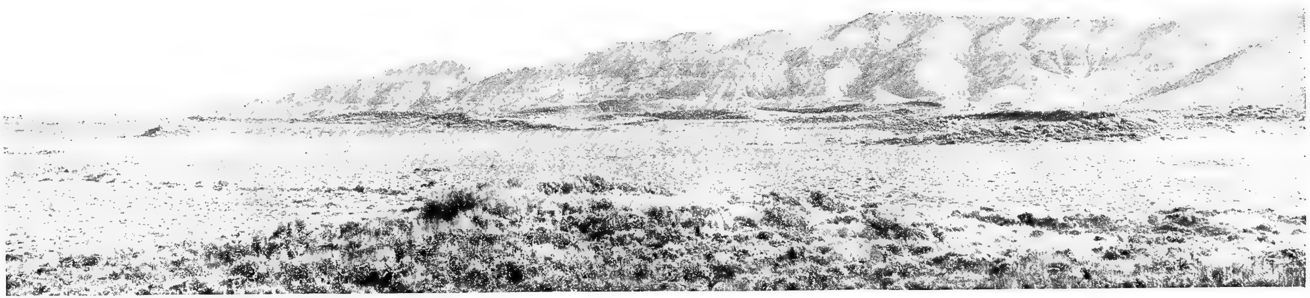


Fig. 3. Sketch map of the Washakie Basin region, southern Wyoming. From King, with additions and slight alterations.

Detail of bad lands along the northwestern face of Haystack Mountain (Hor. B). Showing talus of heavy blocks of coarse green sandstone (No. 22) from the uppermost stratum. The skull of *Dolichorhinus hyognathus* was found near this point.



Haystack Mountain from La Clede Station, looking southeast, up Bitter Creek. The Lower Brown Sandstone rim is shown in the middle distance.



Eastern end of Haystack Mountain. Looking southeast from the Overland Trail. The top of horizon A is at the base of the mountain at this point.

Northwestern point of Haystack Mountain (Hor. B). The white and pink sandstones are well shown in this view. The coarse green sandstone (No. 17) occurs about half way up the mountain.

Outlier along northwestern face of Haystack Mountain (Hor. B), showing dip of strata. Looking southwest. The butte is capped by the coarse pale green sandstone stratum (No. 17).

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Article IV.—THE WASHAKIE, A VOLCANIC ASH FORMATION.

By W. J. Sinclair.

It was at first supposed by King and Marsh that the Middle Eocene deposits of Wyoming in the Washakie and Bridger Basins were contemporaneous or nearly so. Osborn in 1881 pointed out faunistic differences. Analysis of the fauna has finally led: (1) to a faunistic correlation of the lower Washakie with the upper Bridger; (2) to placing the upper Washakie as subsequent to the Bridger. The petrographic examination of the Washakie rocks, based on specimens collected by the American Museum Expedition of 1906, affords valuable evidence for the separation of the Washakie from the Bridger as a distinct formation. The Bridger rocks, as recently ascertained,[1] are composed of rhyolitic ash interstratified with shell marls and thin lignitic bands of lacustrine and swamp origin respectively, while the ash composing the mass of the formation has been distributed, apparently, by both wind and running water.

The Washakie rocks are also volcanic in origin, resembling the Bridger tuffs macroscopically but differing from them in being more basic as shown by the presence of soda-lime instead of potash feldspars. As they are all quite soft more satisfactory results have been obtained by examining them microscopically in powder form than by the usual method of sectioning. They may be described as tuff sandstones, white and green fine-grained tuffs, green and purplish clays and feldspar conglomerates.[2]

Lower Washakie.

1.— *Tuff sandstones.* The basal brown sandstone of the Washakie (Washakie A) may be taken as a good example of rocks of this type. It is composed of rock fragments, mineral grains and pumice. The former comprise small water-worn pebbles of soft tuff, more angular tuff fragments, and small grains of a black rock with opaque inclusions (probably magnetite) and aggregate polarization when crushed and the transparent portions of the resulting powder examined between crossed nicols. Plagioclase with the optical properties of oligoclase-andesine is exceedingly abundant in clear

[1] Sinclair, W. J. Volcanic ash in the Bridger beds of Wyoming. Bull. Am. Mus., Vol. XXII, Article XV, pp. 273–280, 1906.

[2] These observations are based on a series of Washakie rocks from the type locality east of Green River, Wyoming, collected by Mr. Walter Granger of the American Museum Expedition of 1906.

angular grains. Green hornblende is next in abundance and brown biotite, sometimes in foils of hexagonal outline, is present in smaller quantity. Carbonate of lime frequently acts as the cementing substance. A few grains of garnet and zircon are present in some of the sandstones. Pumice occurs abundantly in cottony masses scoriaceous in texture and either isotropic or showing aggregate polarization, with numerous inclusions of small, black, opaque, magnetic grains. Some of the pumice grains are red externally. No quartz has been found.

Upper Washakie.

2. *Tuffs.* These are white and pale green rocks containing the same minerals as the sandstones but in a finer state of subdivision and with pumice predominating. The grains of the latter are almost always devitrified, giving aggregate polarization. Plagioclase feldspars (oligoclase-andesine), hornblende, augite and biotite are among the minerals recognized. No quartz has been identified. Carbonate of lime may be present or absent. Some of the white tuffs show anastomosing root canals conspicuous against the white background by a slight yellow stain. The greenish tuffs usually crumble readily when wet but do not become plastic, while the white tuffs are more resistant, do not crumble and are unaffected by dilute acid.

3. *Clays.* The Washakie clays are greenish and purplish in color, slightly plastic when wet and, when examined microscopically are seen to be composed of exceedingly fine-grained irresolvable material with aggregate polarization.

4. *Feldspar conglomerates.* These are very peculiar rocks composed of small cleavage blocks of plagioclase (oligoclase-andesine) in a matrix of fine, angular feldspar fragments, biotite, hornblende and pumice. The matrix and many of the feldspar grains are of a pale greenish color. More or less calcareous cementation is present. The larger fragments of feldspar have the corners rounded off and are very slightly kaolinized. No quartz has been found in this conglomerate where it should be expected to occur if quartz is a constituent mineral of the Washakie rocks, as the conglomerate is evidently a natural concentrate.

Summary.

The difference in petrographic character between the Bridger and Washakie has an important bearing on the problem of correlation in time.

The Bridger rocks are rhyolite tuffs containing glassy sanidine while the Washakie rocks are andesitic with soda-lime feldspar. From the absence

of agglomerates and the fine-grained character of much of the ash it seems probable that it was transported mainly by the wind, and as the prevailing winds are at present from the west and had probably the same direction in Tertiary time, the centers of eruption should be located somewhere in the west or southwest. The absence of agglomerates does not favor the idea of local contemporaneous vents discharging rhyolitic and andesitic ash respectively and the great thickness and uniform petrographic character of each formation is opposed to the conception of rapid variation in the chemical composition of the ash at a single center of eruption. Assuming contemporaneous deposition from two centers of eruption it seems probable, in view of the comparatively short distance separating the areas occupied by the two formations (about 50 miles)[1] that some intermixture of the two types of ash should be found, but the conspicuous absence of plagioclase feldspar from all the Bridger tuffs and its presence in all those of the Washakie shows that this has not occurred. The lithologic evidence, therefore, does not favor the idea of contemporaneity for any part of the Bridger or Washakie.

The faunistic evidence of contemporaneity of the Lower Washakie and Upper Bridger is therefore in contradiction to the lithological evidence.

Princeton University,
December, 1908.

[1] Estimate based on map of Fortieth Parallel Survey.

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Article V.— THE SPECIES OF *HOLCASPIS* AND THEIR GALLS.

By William Beutenmüller.

Plates VII–IX.

The present paper on the species of *Holcaspis* constitutes the second installment of a series of papers on the North American Cynipidæ and their Galls, which are in course of preparation, the first part being a paper on 'The North American Species of *Rhodites* and their Galls,' published in this Bulletin, Vol. XXIII, 1907, pages 629–651, plates xliii–xlvii.

Holcaspis *Mayr*

Holcaspis Mayr, Gen. Gallenb. Cynip., 1881, pp. 9, 35; Cresson, Synop. Hymen. N. Am., pt. I, 1887, pp. 25, 33; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 62; Psyche, Vol. X, 1903, p. 153.

Agamous. Antennæ 13–14-jointed, first joint stout, second joint very short, stout, third to eighth joints long and slender, gradually decreasing in length, ninth to terminal joints short and somewhat thickened. Head thorax and part of abdomen pubescent. Mesothorax with incomplete parapsidal grooves, abbreviated anteriorly or continuous. Scutellum rounded, convex and without distinct foveæ at the base.

Type: *Callaspidia globulus* Fitch.

Holcaspis globulus (*Fitch*).

Cynips oneratus (in part) Harris, Rep. Ins. Mass. Inj. Veget., 1841, p. 398; Treat. Ins. New Engl. Inj. Veget., 2d edit., 1852, p. 434; Treat. Ins. Inj. Veget., 3rd edit., 1862, p. 548; *ibid.*, new edit., Flint, 1862, p. 548; *ibid.*, 1863, p. 548; *ibid.*, 1880, p. 548 (gall only).

Callaspidia quercus globulus Fitch, 5th Rep. Nox. Ins. N. Y., 1859, (Trans. N. Y. State Agricul. Soc., 1858 (1859), p. 810, fig.; Glover, Ill. N. Am. Ent., 1878, pl. viii, figs. 1, 2, 3; Packard, Bull. 7, U. S. Ent. Com., 1881, p. 39; 5th Rep. U. S. Ent. Com., 1890, p. 111.

Cynips quercus globulus Osten Sacken, Proc. Ent. Soc. Phil., Vol. I, 1861, p. 67.

Cynips q. globulus Osten Sacken, Ent. Zeit. Stettin. Vol. XXII, 1861, pp. 410, 413; Bassett, Proc. Ent. Soc. Phila., Vol. II, 1863, p. 328; Walsh, Proc. Ent. Soc. Phil., Vol. II; 1864, p. 488; Packard, 5th Rep. U. S. Ent. Com. 1890, p. 113.

Cynips globulus Osten Sacken, Proc. Ent. Soc. Phil., Vol. IV, 1865, pp. 339, 345, 349, 350.

Diplolepis globulus Karsch, Zeitsch. Gesammt. Naturwiss., Vol. 3rd Ser., 1880, p. 293.

Loxaulis globulus Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296.

Holcaspis globulus Mayr, Gen. Gallenb. Cynip., 1881, pp. 9, 35; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 305; *ibid.*, Vol. XIV, 1887, p. 130; Bull. 1, Colorado Biol. Assoc., 1890, p. 38; Gillette, 27th Rep. Agricul. Mich., 1888, p. 470; Psyche, Vol. V, 1889, p. 187; Proc. Iowa Acad. Sci., 1890, p. 113; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 260, pl. xii, fig. 4; Am. Mus. Journ., Vol. IV, 1904, p. 105, fig. 37; Ins. Galls Vicin. N. Y., 1904, p. 19, fig. 37; Patton, Ent. News, Vol. III, 1892, p. 104; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 56; Brodie, Ann. Rep. Forest Ont., 1890, p. 116, fig. 24; Bridwell, Trans. Kan. Ac. Sci., Vol. XVI, 1899, p. 204; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54; Cook, 29th Rep. Dept. Geol. Nat. Hist. Indiana, 1904, (1905), p. 835, fig. 27; Felt, Ins. Affect. Park and Woodl. Trees, Vol. II, 1906, p. 624; Jarvis, Rep. Ent. Soc. Ont., 1906 (1907), p. 72.

Cynips rugosa Bassett, Can. Ent., Vol. XIII, 1881, p. 100.

Holcaspis rugosa Mayr, Gen. Gallenb. Cynip., 1881, p. 33; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 304; *ibid.*, Vol. XIV, 1887, pp. 130, 139; Gillette, 27th Rep. Agricul. Mich., 1888, p. 470; Psyche, Vol. V, 1889, p. 187; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 56; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Head cinnamon red, broadly black in front and with a black spot behind the eye, finely punctate; antennæ 14-jointed, black, first and second joints dark rufous. Thorax finely punctate, slightly pubescent, black, subopaque, sometimes narrowly red along the parapsidal grooves, and laterally. Parapsidal grooves distinct, extending to about the middle of the mesothorax and broadly separated at the scutellum where they are somewhat converging. Anterior pair of lines parallel; lateral groove distinct. Scutellum black, evenly rugoso-punctate, foveæ wanting. Abdomen piceous black, darkest dorsally, pubescent laterally at the base. Legs reddish brown, pubescent. Wings, pale yellowish, hyaline, veins brown. Length 3 to 4 mm.

Gall. (Plate VII, Fig. 1, 2, 3; Plate IX, Fig. 12.) On the twigs of white oak (*Quercus alba*), chestnut oak (*Quercus prinus*), scrub chestnut oak (*Quercus prinoides*). Smooth, globular or the shape of a bullet, growing singly or in clusters of two, three or more. Yellow, sometimes tinged with red. Internally of a compact, rather hard, corky texture and containing a free, oval, yellowish brown larval cell, resembling an egg. Diameter 8 to 16 mm.

Habitat. Canada to Texas.

The insect described by Harris as *Cynips oneratus* is a guestfly (*Synergus oneratus*) and *Cynips globulus* of Fitch is the true gall maker. The species described by Bassett as *Cynips rugosa* is inseparable from *Holcaspis globulus*, at least I am unable to find any perceptible differences beween the two species.

The types of Harris are in the Boston Society of Natural History and Bassett's types of *H. rugosa* are in the American Museum of Natural History and the American Entomological Society. Fitch's type of *H. globulus* is lost.

Holcaspis omnivora (*Ashmead*).

Cynips q. omnivora Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. vi.

Andricus omnivorus Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 295, 303; Dalla Torre and Kieffer, Gen. Ins. Hymen., Fam. Cynip., 1902, p. 64.

Holcaspis omnivora Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 130; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 56.

Female. Wholly reddish brown, except the anterior pair of grooves and lateral lines on the thorax, black, pubescent. Antennæ blackish, basal joints rufous. Head finely rugosely punctate. Thorax finely and evenly punctate. Parapsidal grooves extending forward to nearly the middle of the mesothorax. Anterior pair of lines extending backward to a little beyond the middle. Lateral grooves distinct. Scutellum rugose. Abdomen shining, basal segment pubescent. Wings hyaline, veins fine, second cross-vein heavy. Areolet large. Cubitus disappearing at the middle from its origin. Length, 3 to 4 mm.

Gall. (Plate VII, Figs. 4, 5, 6, 7.) Singly or in clusters of two or three on the twigs of different kinds of oaks (*Quercus brevifolia, Quercus catesbæi; Quercus virginiana, Quercus minor,* and *Quercus chapmani*). Globular or irregularly rounded, sometimes confluent. Hard, pale brown or yellowish, sometimes tinged with red. Internally there is a small larval cell, sometimes loose, but more often attached to the hull near the bud axil. Diameter 8 to 20 mm.

Habitat. Florida.

The gall of this species resembles that of *Holcaspis globulus*, but the fly is almost entirely rufous while *Holcaspis globulus* is nearly black.

Holcaspis mamma (*Walsh*).

Cynips q. mamma Walsh, Am. Ent., Vol. I, 1869, p. 102.

Holcaspis mamma Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 130; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 56; Bridwell, Trans. Kan. Acad. Sci., Vol. XVI, 1899, p. 204.

Holcaspis duricoria Mayr, Gen. Gallenb. Cynip., 1881, p. 35; Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 64; Gillette, 27th Rep. Agricul. Mich., 1888, p. 430, fig. 3; Psyche, Vol. V, 1889, pp. 187, 216, fig. 3; Proc. Iowa Acad. Sci., Vol. I, pt. ii, 1892, p. 113; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 261, pl. XII, fig. 5; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54; Felt, Ins. Affect. Park and Woodl. Trees, Vol. II, 1906, p. 624.

Cynips duricaria Packard, 5th Rep. U. S. Ent. Com., 1890, p. 113.

Holcaspis duricaria Beutenmüller, Am. Mus. Journ., Vol. IV, 1904, p. 106, fig. 38; Ins. Galls Vicin. N. Y., 1904, p. 20, fig. 38; Jarvis, Rep. Ent. Soc. Ont., 1906 (1907), p. 71.

Diplolepis q. macrocarpæ Karsch, Zeitsch. Gesammt. Naturwiss., Vol. V, 3d ser., 1880, p. 291, pl. vi, figs. I, Ia.

Cynips macrocarpæ Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 73.

Andricus macrocarpæ Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 63.

Female. Head rufous, face narrowly black, or sometimes black with the cheeks

rufous, very finely rugose, pubescent. Antennæ 13-jointed, black, basal joint rufous. Thorax rufous, black between the anterior pair of grooves and along the lateral lines, sometimes black with only slight traces of rufous, finely punctate, and pubescent. Pleuræ usually rufous, sometimes marked with black. Parapsidal grooves distinct, broadest at the scutellum and extending forward to a little beyond the anterior lines. Lateral lines, shining and well marked. Anterior pair of grooves distinct. Scutellum rugose, rufous, sometimes marked with black basally, foveæ wanting. Abdomen rufous or pitchy brown, hairy basally at the sides. Legs rufous, hairy. Wings hyaline, somewhat dusky, cubitus disappearing before reaching the first cross-vein; second cross-vein infuscated. Areolet large. Length 2.50 to 4.50 mm.

Gall. (Plate VIII, Fig. 1.) In numbers or in clusters among the twigs of swamp white oak (*Quercus platanoides*) and bur oak (*Quercus macrocarpa*). Rounded, hard, and woody when old, brown or dark red, with a more or less distinct point at the apex. When fresh it is bright red, sometimes greenish, soft and pithy. Internally there is a free larval cell, similar to that of *Holcaspis globulus.* Diameter 6 to 18 mm.

Habitat. Canada to Texas.

I have united *Holcaspis duricoria* Bassett, with *H. mamma* Walsh. The description of the gall of the latter tallies exactly with that of the former, while the brief characters of the adult of *H. mamma* agrees with those of *H. duricoria.* Walsh compared his *H. mamma* with *H. globulus* and his diagnosis agrees essentially with the material of these species before me. A specimen of *H. mamma* was given to me by the late Dr. Ashmead, and I cannot separate it from *duricoria.* Bassett also suspected that *H. duricoria* was probably identical with *H. mamma,* and his species had long borne the name as a manuscript designation before the description was published. The gall of *mamma* is sometimes found in countless numbers on a single tree.

The types of the adults and galls of *duricoria* are in the American Museum of Natural History and the American Entomological Society. The types of *H. mamma* were lost in the great Chicago fire.

Holcaspis rubens *Gillette.*

Holcaspis rubens Gillette, Ent. News, Vol. IV, 1893, p. 29; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Head rufous, coarsely punctate. Antennæ dark rufous, terminal joints black. Thorax evenly punctate, rufous except the anterior parts of the two parallel lines, line at base of scutellum, sutures of thorax, sternum, and metathorax black. Parapsidal grooves distinct, widely separated at the scutellum and extending only about half way forward. Anterior parallel grooves distinct. Lateral lines long and extending well forward. Scutellum rugose, foveæ wanting but with a narrow transverse groove at the base. Abdomen globose, not compressed, shining, pubescent at sides of base, rufous, ventral sheath black. Legs rufous. Wings hyaline, veins fine, second cross-vein heavy. Cubitus not reaching the first cross-vein. Length, 4 to 5 mm.

Gall. (Plate VII, Figs. 8, 9.) Singly or in clusters on the twigs of oak (*Quercus undulata*). Globular and composed of a dense corky substance, containing a single larval cell that is easily detached from the surrounding portions. Smooth or rough externally and of a light straw color, usually tinted with red. Diameter 10 to 14 mm.

Habitat. Colorado.

The gall very much resembles that of *Holcaspis globulus* but the flies are very different. The types are with Prof. C. P. Gillette and in the American Museum of Natural History.

Holcaspis persimilis *Ashmead.*

Holcaspis persimilis Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 126; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Head, antennæ, thorax and legs brown, and pubescent. Vertex of head, and streaks on the thorax black. Antennæ rather long, 13-jointed. Head and thorax punctate. Parapsidal grooves obsolete anteriorly. Anterior pair of grooves, extending backward to more than half the length of the mesothorax. Lateral grooves long. Pleuræ punctate, pubescent. Abdomen black, pubescent at the sides basally; apices of the short terminal segments dull rufous. Spine of ventral valve long and hairy. Wings hyaline, veins blackish brown, areolet distinct, surrounding veins delicate, except the outer vein which is thick and angulated, cubitus open at base; vein at base of radial cell angulated. Length 4 mm.

Gall. (Plate VIII, Figs. 15, 16.) On the twigs of black jack oak (*Quercus marylandica*). Rounded, hard, rugose externally, with raised lines and ridges. Otherwise similar in structure to other Holcaspid galls. Diameter 7 mm.

This species is unknown to me. The types of the single adult and gall are in the United States National Museum; the habitat is unknown. According to Ashmead the adult may be known from the congeners by the angulated outer vein of the areolet.

Holcaspis bassetti *Gillette.*

Holcaspis bassetti Gillette 27th Rep. Agricul. Mich., 1888, p. 472, fig. 2; Psyche, Vol. V, 1889, p. 215, fig. 2; Proc. Iowa Acad. Sci., 1890, p. 54; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Holcaspis bassettii Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 55.

Female. Head cinnamon brown, median line of face and vertex dark brown to black; occiput and ocelli black; clypeus and border of epicranium black; mandibles black at tip and base; finely rugose with short hairs. Antennæ 13-jointed brown black, first and second joint rufous. Mesothorax black, with a red brown line outside of the parapsidal grooves, this line extends and connects with a reddish brown patch on each side of the anterior portion of the thorax. Pleuræ finely rugose, hairy and without a shining area. Parapsidal grooves begin midway on the thorax and extend back to the scutellum where they are widely separated. A little forward to these grooves the two parallel smooth lines arise and extend forward to the collar. On each side near the base of the wings is a smooth black line that runs to the scutel-

lum. Scutellum black, reddish brown at tip, evenly rugose. Abdomen pitchy black, ventral spine brown, hairy, first segment with minute, grayish hairs. Legs reddish brown. Wings pale yellowish brown, hyaline, veins distinctly brown. Length 3 mm.

Gall. (Plate VIII, Figs. 6, 7.) Singly or in clusters from two to about thirty, closely crowded together on the twigs of swamp white oak (*Quercus platanoides*) and "shingle oak (*Quercus imbricaria*). Green and soft when fresh and often tinged with pink. Hard, woody and brown, when old and dry. Monothalamous, rounded or irregular at base, broadly attached to the twig, and gradually drawn out into a more or less prominent point at the apex, which is sometimes curved. Larval cell at base of gall and somewhat pointed at the end toward the twig.

Habitat.— Ohio; Michigan; Iowa.

The types are with Prof. C. P. Gillette.

Holcaspis sileri *Bassett.*

Holcaspis sileri Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 67; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 56; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Dull dark reddish brown, except the abdomen which is black and shining. Thorax pubescent and punctate. Parapsidal grooves from scutellum half way to the collar, diverging. Anterior parallel lines somewhat more than half to the scutellum, distinct and smooth. Lateral lines deep. A short medium line from the scutellum, which does not reach forward to the parallel lines. Abdomen black, second segment pubescent at the sides. Legs dark reddish brown, tarsi darker, claws two toothed. Wings hyaline, veins slender, dark. Areolet small, cubitus not continuous to the first cross-vein.

Gall. (Plate VIII, Fig. 12.) Singly at the tip of twig of oak (*Quercus undulata*). Somewhat bud-shaped, ovate, or elongate. Attached by a broad base to the twig near the bud, pointed at the apex with part of a leaf growing from it or at the sides. Rough and apparently green when fresh, brown and pubescent when dry Internally the gall is hard with the larval cell closely imbedded, but separated from the gall. Length about 9 mm. Width about 5 to 6 mm.

Habitat. Southern Utah.

The adult of this species has not been examined by me. It is in the collection of the American Entomological Society and two type galls are in the American Museum of Natural History.

Holcaspis canescens *Bassett.*

Holcaspis canescens Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 66; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 55; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Female. Head and thorax dark brownish, and less hirsute than *H. corallinus.* Legs almost resinous in appearance. Abdomen black and shining with a tinge of brown and the hairiness is confined to the sides of the second, third, and fourth segments, and is so very sparse, short and fine, as to escape observation unless highly

magnified. The parallel lines on the mesothorax are more widely separated than in *corallinus.* Lines over the base of each wing, darker, broader, and shining. Parapsidal grooves very inconspicuous. Wings with radial area large. Length about 4 mm.

Gall. In clusters on the branch of a species of dwarf oak (*Quercus* sp.) Rounded, hard, and woody, with a blunt spur at the apex. Resembling dwarf specimens of *Holcaspis duricoria,* though the surface is more hoary. Internally, there is a single larval cell, attached to the gall, but can be detached without breaking; around the cell there is a thin layer of rusty brown, and outside this a light gray color prevails. Diameter 10 mm.

Habitat. California.

The type is in the American Entomological Society.

Holcaspis arizonica *Cockerell.*

Holcaspis arizonica Cockerell, Can. Ent., Vol. XXXIV, 1902, p. 183.

Female. Antennæ 15-jointed, third joint longest. Head ferruginous. Thorax and abdomen piceous; margins of mesothorax and two spots on scutellum dull ferruginous. Legs bright ferruginous. Anterior tibiæ with an apical projection; anterior tibial spurs bent; claws of all the legs falciform, with a large triangular basal tooth. Outer parapsidal grooves failing anteriorly. Scutellum large, rounded, hairy and without grooves. Sides of thorax and abdomen, except the upper basal portion with much glittering white hair. Abdomen with a short ferruginous hairy projection beneath. Ovipositor not visible. Naked portion of abdomen smooth and polished, hairy portion minutely tessellate, with a tendency to oblique grooves, only visible with a compound microscope. Wings strongly clouded on apical half, nervures piceous, Areolet present. Length of body 3.50 mm. of wings 3.33 mm.; of antennæ 2 mm.

Gall. Attached to the base of the petiole of leaf of oak (*Quercus arizonica*). Globular, pale ochreous, not shining. There is a projecting point next to the place of insertion. Inside it is brown, fiberous, moderately dense, with at least two cells. Diameter 9 mm.

Habitat. Prescott, Arizona.

This species is unknown to me. According to T. D. A. Cockerell it is closely related to *Cynips sulcatus* Ashmead, but differs by its much darker color and infuscated wings, and seems to go best in *Holcaspis.* The type, according to Prof. T. D. A. Cockerell, is with the American Entomological Society.

Holcaspis colorado *Gillette.*

Holcaspis colorado Gillette, Ent. News, Vol. IV, 1893, p. 210; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Female. "Black, shaded with rufous. Head dark rufous with parts bordering the mouth, middle portion of face and vertex black or nearly so; antennæ 13-jointed, black, third joint slightly longer than the fourth. Thorax rather coarsely punctured, and from each puncture arises a gray hair. The general color of the thorax is black, but there is a tinge of rufous upon the shoulders and between the parapsidal grooves;

parapsidal grooves black, and rather broad at the scutellum, but extending only about half way to the collar; median groove wanting, parallel lines extending back from the collar, distinct. Lines over the base of wings black, smooth and shining; scutellum grooved at base, rugose, sparsely haired, and darker in color than the mesothorax. Pleuræ densely punctured, the punctures giving rise to fine white hairs. Abdomen black, polished, second segment hardly covering more than one third of the dorsum; the abdomen is truncate and compressed laterally, the greatest depth from the dorsum to the venter being greater than the length. Wings hyaline, 4.2 mm. long; nervures black, but not heavy; areolet rather large. Feet blackish, tinged with rufous; tibiæ darker than femurs. Length 3.6 mm. (C. P. Gillette)."

Gall. In clusters on the twigs of a species of oak (*Quercus*, sp.). Globular and drawn out into a blunt point at the apex. Hard and woody and resembles small dark colored galls of *H. rugosa.* The substance is more dense than in *rugosa* and *gobulus* and the central cell does not separate from the cellular tissue. Length 10 mm. Width 8 mm.

Habitat. Colorado (Manitou).

This species is unknown to me and the type of the adult and gall are with Prof. C. P. Gillette. It was described from a single living female which was cut from a gall October 31, 1892.

Holcaspis cinerosa (*Bassett*).

Cynips cinerosa BASSETT, Can. Ent., Vol. XIII, 1881, p. 110.

Andricus cinerosus ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1884, pp. 295, 304; *ibid.*, Vol. XIV, 1887, p. 130; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 82; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 62.

Female. Head rufous, tips of mandibles black, finely punctate and covered with short grayish hairs. Ocelli black. Antennæ rufous tinged with black, hairy. Thorax rufous, anterior pair of median lines and space between these black. A black shade line on each side containing the shining groove at the base of each wing. This black shade terminates some distance before the anterior edge of the thorax; finely rugoso-punctate and covered with appressed grayish hairs. Parapsidal grooves distinct extending to about the middle of the mesothorax where they are widely separated. Anterior pair of parallel lines distinct, and extending to the middle of the mesothorax. Median groove from the scutellum short. Scutellum finely and evenly rugoso-punctate, rufous and covered with appressed grayish hairs; foveæ wanting. Abdomen reddish brown, pitchy brown black dorsally, or almost wholly pitch brown black; first segment, and anterior part of second segment with fine grayish hairs laterally. Legs brown, hairy, claws black. Wings hyaline, veins brown, second-cross vein infuscated. Cubitus disappearing before reaching the first cross-vein. Areolet large triangular. Anal vein broken before the middle. Length 3 to 4 mm.

Gall. (Plate VII, Fig. 10.) Singly or in clusters of two or three on the twigs of live oak (*Quercus virginiana*). Monothalamous. Globular with a distinct pointed nipple at the apex, and covered with a dense mealy grayish powder. Internally it is of a dense corky or cellular structure, containing a partly free central larval cell. Diameter 12 to 22 mm.

Habitat. Texas.

A distinct species, readily known by the dense grayish pubescence on the thorax and sides of the abdomen; clear hyaline wings with the cubitus of the primaries disappearing before reaching the first cross-vein. The gall is perfectly globular with a nipple at the apex and differs from all other known *Holcaspis* galls by the dense grayish powder covering it.

The types are in the American Entomological Society. A fine lot of galls of *H. cinerosa,* from Austin, Texas, were kindly sent to me by Mr. C. Hartman.

Holcaspis corallina *Bassett.*

Holcaspis corallinus Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 66.

Holcaspis corallina Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 55; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Female. Reddish brown, antennæ brownish black, thickly covered with short silvery white hairs except a small spot on the dorsal ridge of the abdomen; the hairs on the antennæ and middle of the pleuræ are shorter and less conspicuous. Head somewhat paler than the thorax. Lines on the thorax darker than the general surface; two closely contiguous, smooth, parallel lines from the collar extending half way to the scutellum. Parapsidal grooves very widely separated at the scutellum, shallow and almost hidden by the appressed hairs and disappearing before reaching the middle of the mesonotum. Scutellum rounded, foveæ wanting. Abdomen more densely hairy than the remaining parts of the body. Legs somewhat paler than the body. Claws one-toothed. Wings hairy, veins dark, cubitus not quite reaching the first cross-vein; radial area open, basal vein angulated. Areolet small. Length 4 mm.

Gall. (Plate IX, Figs. 13, 14.) On twigs of a species of dwarf oak (*Quercus,* sp.) Coral-shaped, rounded with the surface irregularly and thickly studded all over with short, stumpy projections which differ in size. Reddish buff-colored when fresh and blackish when old; covered closely with a velvety pubescence. Internally the gall is yellowish brown and contains a single, attached, larval cell. Diameter 7 to 10 mm.

Habitat. California.

The types are in the American Entomological Society and type galls in the American Museum of Natural History.

Holcaspis douglasi *Ashmead.*

Holcaspis douglasii Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 127.

Holcaspis douglasi Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Female. Reddish brown, abdomen sometimes nearly black, tibiæ and tarsi sometimes dark brown, pubescent. Anterior pair of lines and groove on each side at the base of the wing, on a black surface. Parapsidal grooves delicate, but distinct throughout. Anterior pair of lines from the collar and lateral groove at base of each wing distinct. Pleuræ shining, but punctate. Foveæ at base of scutellum, con-

fluent, not separated by a carina. Wings hyaline, pubescent, veins blackish, radius slightly incrassate at tip and the vein at the base of radial cell angulated. A discolored streak below the areolet and a large brownish mark below the middle of the radius in the apical cell. Length 2.6 to 3 mm.

Gall. (Plate VIII, Figs. 10, 11.) On the under side of the leaf of oak (*Quercus douglasi*) Brown and covered with a lilac gray bloom. Squash shaped, with many ridges surrounding the upper margin, being prolonged into irregular tubercles, usually from seven to ten in number. From the base to the upper margin the gall gradually increases in width. Internally it is hollow and with an egg-shaped partly attached larval chamber. Height 7 to 10 mm. Width at upper margin 6 to 10 mm.

Habitat. California (Marin Co.).

The gall of this species is very different in shape from that of other *Holcaspis*. It is somewhat of the shape of a diminutive squash and covered with a delicate lilac gray bloom which is easily rubbed off. The types are in the United States National Museum.

Holcaspis truckeensis *Ashmead.*

Holcaspis truckeensis Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 127; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Head and thorax punctate, brownish yellow, covered with glittering white pubescence. Antennæ yellowish brown, first and second joints black. Pleuræ and metathorax blackish, shining. Parapsidal grooves, anterior parallel grooves and lines over the base of the wings distinct. Scutellum yellowish brown, rugose. Abdomen yellowish brown, highly polished pubescent at sides of second segment; ventral spine, stout, hairy. Wings hyaline, veins brown. Areolet distinct, cubital cell open at base. Basal vein of radial cell only obtusely angular. Length, 3.4 mm.

Gall. (Plate VIII, Fig. 13.) On the terminal twig of oak (*Quercus chrysolepis* var. *vaccinifolia*). Irregular, inflated, hard, woody gall issuing from a slit in a terminal twig. Brown, somewhat smooth with transverse depressions, caused by the coalescence of several galls. Length about 25 mm. Width about 12 mm.

Habitat. California.

The types are in the United States National Museum.

Holcaspis eldoradensis sp. nov.

Female. Head yellowish brown minutely punctate pubescent. Antennæ very slender, brown, darker toward the tip. Thorax yellowish brown, black along the parapsidal grooves and between the anterior parallel lines, pubescence pale. Parapsidal grooves deep, distinct, shining. Anterior parallel lines distinct and extending to about the middle of the mesothorax. Scutellum yellowish brown, finely and evenly rugose. Pleuræ yellowish brown, punctate. Abdomen yellowish brown, dark along the dorsum. Legs yellowish brown pubescent. Wings hyaline, veins brown. Length 3 mm.

Gall. (Plate IX, figs. 6, 7.) On the twigs of *Quercus kelloggii*. Hard woody and with the base broadly inserted in a slit on the branch. Rounded with the top

very much flattened. Sides pale brown, wrinkled, summit dark brown and rugose. Centrally is a single larval cell. Width 4–7 mm. Height about 4 mm.

Habitat: Sonoma County, California.

Type: One female and gall. Collection American Museum of Natural History.

Holcaspis perniciosa (Bassett).

Cynips quercus mellaria Riley, Am. Ent., Vol. III, 1890, p. 298; McCook, Honey Ant, 1882, p. 27, pl. iv, figs. 7–12 (galls only).

Holcaspis perniciosus Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 68; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. XXIII, 1907, p. 465; Wheeler, Bull. Am. Mus. Nat. Hist., Vol. XXIV, 1908, p. 378, fig. 23.

Holcaspis perniciosa Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 56; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Holcaspis monticola Gillette, Ent. News., Vol. IV, 1893, p. 30; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Head very dark rufous, face almost black in the middle; vertex black, finely rugose. Antennæ blackish brown, shining, minutely pubescent. Thorax dark pitchy brown or almost black, sometimes tinged with very dark reddish brown, finely punctate, sparsely pubescent. Parapsidal and anterior pair of grooves, distinct, but not prominent, lateral lines present. Scutellum, piceous, tinged with rufous, foveæ wanting. Abdomen pitchy brown black, first segment pubescent at sides. Legs dark reddish brown. Wings hyaline, veins brown. Areolet large. Length 2.50 to 3 mm.

Gall. (Plate IX, Figs. 8, 9.) In clusters on the twigs of oaks (*Quercus undulata* and *Quercus gambelii*). Monothalmous. Rounded with the apex more or less pointed or somewhat flattened, attached by a broad base to the twig which is enlarged into a shallow cup-like receptacle at the base of the gall. When fresh the gall is bright-colored, inclining to crimson or scarlet; when old, dark brown, hard, woody and containing a larval cell firmly imbedded in the rather hard cellular tissue. Smooth or slightly rough and sometimes with deep, irregular cracks. The adult escapes through an opening which it makes at the base of the gall. Diameter 5 to 8 mm.

Habitat Colorado; New Mexico; Utah; Arizona.

A distinct species, redescribed as *Holcaspis monticola* by Prof. C. P. Gillette. Riley, in 1880, briefly described the galls under the name *Cynips quercus mellaria.* This name should not be accepted since it is based merely on the plant deformation. According to McCook the galls exude minute drops of a sweet, watery secretion which is collected by the honey ant (*Myrmecocystus hortideorum*). This liquid is eagerly collected by the ordinary workers, carried to their nests in their crops and fed to the repletes, and otherwise serving as food when other sources are exhausted.

The types of *H. perniciosus* are in the American Entomological Society, and those of *H. monticola* are with Prof. C. P. Gillette and the American Museum of Natural History.

Holcaspis succinipes (*Ashmead*).

Cynips q. succinipes Ashmead, Trans. Am. Ent. Soc., Vol. IX, 1881, p. xi.

Andricus succinipes Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 291; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 65.

Holcaspis succinipes Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 132; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 56.

Female. Head brown, finely granulated, face covered with rather long whitish or yellowish white pubescence; ocelli black. Antennæ 13-jointed, reddish brown. Thorax reddish brown rather densely pubescent, two black subdorsal vittæ, extending from the middle of the mesothorax forward to the collar in a straight line with the outer ocelli. Parapsidal grooves distinct, brownish black, two small grooves between these and just back of the black vittæ, converging toward the scutellum not quite reaching the hinder edge; the grooves are blackish and also the surface of the mesothorax a short distance along the edge. Scutellum rounded, punctate, pubescent. Abdomen dark brown, smooth, basal part of second segment reddish. Legs amber colored. Wings hyaline, veins brownish and strongly defined, radial area nearly closed. Areolet closed, the closing vein very pale. Length 3.50 to 4 mm.

Gall. (Plate VII, Fig. 11; Plate VIII, Fig. 14.) In clusters of from five to twenty or more crowded around a terminal twig or branch of live oak (*Quercus virginiana*). Globular or bud-shaped with a broad flattened or excavate base. Yellowish brown, with a surface like buckskin, becoming blackish brown with age. Internally hard, and tough with a single hard, smooth larval cell. Diameter 3 to 6 mm.

Habitat. Florida.

The types are in the United States National Museum.

Holcaspis ficigera (*Ashmead*).

Cynips q. ficigera Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. vi.

Loxaulis ficigera Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296.

Holcaspis ficigera Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 132; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 56; Bridwell, Trans. Kan. Ac. Sci., Vol. XVI, 1899, p. 204. Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Reddish brown, abdomen dark brown above. Anterior pair of parallel lines on the thorax and groove on each side at the base of the wing, black. Head and thorax finely rugosely punctate, pubescent; parapsidal grooves distinct extending forward to middle of mesothorax. Scutellum evenly rugose, pubescent foveæ wanting. Abdomen pubescent at base. Legs yellowish brown or rufous, pubescent. Wings hyaline, veins fine brown, cross-veins rather heavy. Areolet large. Length 2.50 to 3 mm.

Gall. (Plate VIII, Figs. 2, 3, 4, 5.) In clusters thickly crowded together around a twig of live oak (*Quercus virginiana*) compressing each other and shaped accordingly. Outwardly they resemble compressed figs and are of a yellowish brown color. When not compressed they are rounded with a flattened base. Hard and woody and covered with a felt-like substance. Internally the gall is hard and surrounds a

smooth kernel, which is plainly visible on detaching a gall, a part of the kernel being imbedded, and when detached it leaves an indentation in the twig.

Habitat. Georgia; Florida; Kansas.

The types are in the United States National Museum.

Holcaspis spongiosa (*Karsch*).

Diplolepis spongiosus KARSCH, Zeitsch. Gesam. Naturwiss., Vol. V, 3d ser. 1880, p. 295, pl. vi, figs. 5, 5a.

Cynips spongiosa DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 76; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 60.

Cynips q. ficula BASSETT, Can. Ent., Vol. XIII, 1881, p. 75.

Loxaulis ficula ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296.

Holcaspis ficula ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 303; *ibid.*, Vol. XIV, 1887, pp. 132, 135; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 56; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Head cinnamon red with a black line on the face, finely punctate, pubescent. Antennæ blackish. Thorax black, reddish along the parapsidal grooves, and at the sides, finely punctate and pubescent. Parapsidal grooves distinct and extending forward to about the middle of the mesothorax. Anterior pair of parallel lines very indistinct or wanting. Lateral lines distinct, black. Pleuræ reddish brown. Scutellum rugose, foveæ wanting. Abdomen reddish brown, darker dorsally. Legs dark reddish brown, pubescent. Wings hyaline, veins slender, dark brown. Cubitus disappearing before reaching the first cross-vein. Areolet small. Length 2.50 to 4 mm.

Gall. (Plate IX, Figs. 10, 11.) Closely compressed clusters surrounding the twigs of burr oak (*Quercus macrocarpa*), post oak (*Quercus minor*) and *Quercus chapmani.* The individual galls in these clusters assume a variety of forms, by reason of their lateral pressure which they exert upon each other. The normal form would undoubtedly be that of a regular cone attached by its apex to the branch. The galls form a rounded or elongated or globular symmetrical mass, somewhat resembling that of pressed figs. Externally they are thin-shelled and are usually covered with a rust-colored velvety substance which mostly disappears from the outward and exposed surface. Internally it is composed of a soft spongy reddish brown substance and contains a hard larval cell not separable from the spongy substance. The masses are usually very closely compact giving them the appearance of being one large gall, with fissures and depressions indicating the individual galls. Length 25 to 50 mm. Diameter 16 to 38 mm.

Habitat. Georgia; Florida; Texas.

The types of *H. ficula* are in the American Entomological Society and the American Museum of Natural History, and the types of *H. spongiosus* are probably in the Berlin Museum.

The description and figure of the gall of *H. spongiosus* agree with that of *H. ficula.* The adult was briefly described from a broken example and Dr. Karsch stated that the same together with the characteristic gall would serve to recognize the species.

Holcaspis brevipennata *Gillette.*

Holcaspis brevipennata Gillette, Ent. News, Vol. IV, 1893, p. 31; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 53.

Female. Head yellowish rufous, very finely rugose, hairy, median elevation smooth. Ocelli black. Antennæ yellowish rufous from the first to sixth joints, remaining joints blackish. Thorax yellowish rufous, sparsely covered with short hairs, very finely rugoso-punctate, parapsidal grooves distinct, entire; anterior pair of grooves wanting. Pleuræ very finely rugoso-punctate, with a large shining area. Scutellum coarsely but evenly rugose with two foveæ at the base, hairy. Abdomen yellowish rufous above, piceous beneath. Legs yellowish rufous, hairy. Wings extending a little beyond the abdomen, hyaline. Veins black, transverse and radial ones heavy. In the apical cell are two dusky patches. Areolet wanting. Length 3 mm.

Gall. (Plate IX, Figs. 4. 5.) Attached singly to the under side and always near the margin of the leaves of oak (*Quercus undulata*). Globular thin shelled; straw color more or less stained with rusty brown. The central cell is held in place by a rather abundant growth of fine radiating fibres, more or less branched toward their outer ends. Diameter 11 to 18 mm.

Habitat. Manitou, Colorado. (Gillette.)

The gall somewhat resembles that of *Dryophanta polita,* but is more fragile and thin shelled. The wings of the adult extend slightly beyond the abdomen. The parapsidal grooves are continuous and the anterior part of parallel lines are wanting. The types of the adults and galls are with Prof. C. P. Gillette and in The American Museum of Natural History.

Holcaspis centricola (*Osten Sacken*).

Cynips quercus centricola Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1861, p. 58.

Cynips q. centricola, Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1862, pp. 246, 247.

Cynips centricola Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 339, 345, 347, 350.

Loxaulis centricola Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296.

Holcaspis centricola Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 304; *ibid.,* Vol. XIV, 1887, p. 127; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 55; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, pp. 53, 82; Cook, 29th Rep. Dept. Geol. Nat. Hist. Indiana, 1904 (1905), p. 836, fig. 28.

Female. Head black, sometimes with a red spot on each side of the ocelli, finely and evenly rugoso-punctate, sparsely hairy; palpi and mandibles rufous. Antennæ black, with short pale hairs. Thorax black, subopaque, finely and evenly rugoso-punctate, with yellowish pubescence. Parapsidal grooves start from the humeri and converge toward the scutellum, where they are scarcely separated. Median groove from scutellum absent. Anterior parallel lines distinct and reaching the middle of the thorax. On each side above the base of the wings is a smooth, broad,

shining line, the anterior end of which is very near the parapsidal groove. This line runs backward to the scutellum. Scutellum black or rufous, finely rugose, pubescent, and with slight traces of a median line; foveæ at base flat and rugose at bottom; on each side of these there is a tuft of yellowish hairs. Abdomen pitchy brown black, smooth, shining, pubescent at base. Ventral spine brown with long yellow hairs. Legs pitchy black, coxæ, knees, and tarsi brown, pubescent. Wings hyaline, radial and cross-veins very broad and stout, dark brown; radial vein slightly arched; second transverse vein angular. Areolet large, triangular. Anal vein with a brown cloud before the middle. A brown cloud near the base of the apical cell and a few brown marks towards the tip of the wing. Length 2.50 to 3.50 mm.

Gall. (Plate IX, Fig. 1.) On the undersides of the leaves of post oak (*Quercus minor*). Globular flattened at base and attached to the leaf by a small nipple. Thin shelled white, sometimes tinged with pink and covered with a white pubescence, this being the character of the under side of the leaf of the post oak. Internally there is a central kernel which is held in position by numerous, white, silky filaments, radiating from the kernel to the shell of the gall. Diameter 15 to 20 mm.

Habitat. Washington, D. C.; New Jersey; Indiana.

A very distinct species and different from all other known *Holcaspis*. In the adult the parapsidal grooves extend from the shoulders, where they are widely separated, backward to the scutellum, where they are close together. The line at base of wing is curved anteriorly and the wings are clouded apically and on the anal vein. The gall superficially resembles that of *Amphibolips inanis*. It is possible that the species may not belong to the genus *Holcaspis* and I place it in this genus tentatively. The types are in the Museum of Comparative Zoölogy at Cambridge, Mass.

Holcaspis maculipennis *Gillette.*

Holcaspis maculipennis GILLETTE, Can. Ent., Vol. XXVI, 1894, p. 236; COCKERELL, Trans. Kansas Acad. Sci., Vol. XVI, 1899, p. 213; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 54.

Female. Head rufous, middle of face sometimes black, finely punctate and pubescent. Antennæ black. Thorax finely rugose, black, rufous along the parapsidal grooves and sides, over the bases of the wings. Sometimes wholly rufous or marked with black between the anterior pair of grooves and the lateral lines, pubescent. Parapsidal grooves distinct and extending from the collar to the scutellum where they converge and are not widely separated. Anterior pair of lines extending to a little beyond the middle of the mesothorax. Median groove from the scutellum faintly indicated, abbreviated. Pleuræ finely rugose, rufous, sometimes marked with black. Scutellum finely rugose, rufous; foveæ indistinct. Abdomen varying from rufous to piceous, wholly pubescent. Legs rufous to piceous. Wings long, hyaline; veins brown with pale brown clouds and numerous, small brown spots in the apical cell. Length 3 to 5 mm.

Gall. (Plate IX, Figs. 2, 3.) Single or in clusters of two or more, on the upper and under sides of the leaves of oak (*Quercus wrightii, Quercus undulata, Quercus*

garryana), and probably other allied species. Globular, yellowish, composed of a thin outer shell and a single larval cell held in place by radiating fibres. Yellowish brown when dry and covered with darker brown rounded spots. Diameter 15 to 35 mm.

Habitat. New Mexico; California; Oregon.

The maculation of the wings is unlike that of any other species of *Holcaspis,* and the species may be readily known by the continuous parapsidal grooves. The gall resembles that of *Amphibolips inanis.*

The types are with Prof. C. P. Gillette. I have bred several specimens of the flies from galls collected at Portland, Oregon, by Dr. E. O. Hovey.

Holcaspis chrysolepidis *Ashmead.*

Specimens of galls (Plate VIII, figs. 8, 9) under this name were given to me by W. H. Ashmead, and other specimens of the galls are in the United States National Museum. They are from Placer County, California, and occur on the twigs of *Quercus chrysolepis.* The adult has not been described.

EXPLANATION OF PLATES.

Plate VII.

Fig.	1.	*Holcaspis*	*globulus* Fitch.
"	2.	"	*globulus* Fitch.
"	3.	"	*globulus* Fitch, inside view.
"	4.	"	*omnivora* Ashmead.
"	5.	"	*omnivora* Ashmead, double galls.
"	6.	"	*omnivora* Ashmead, double gall.
"	7.	"	*omnivora* Ashmead, inside view.
"	8.	"	*rubens* Gillette.
"	9.	"	*rubens* Gillette.
"	10.	"	*cinerosa* Bassett.
"	11.	"	*succinipes* Ashmead.

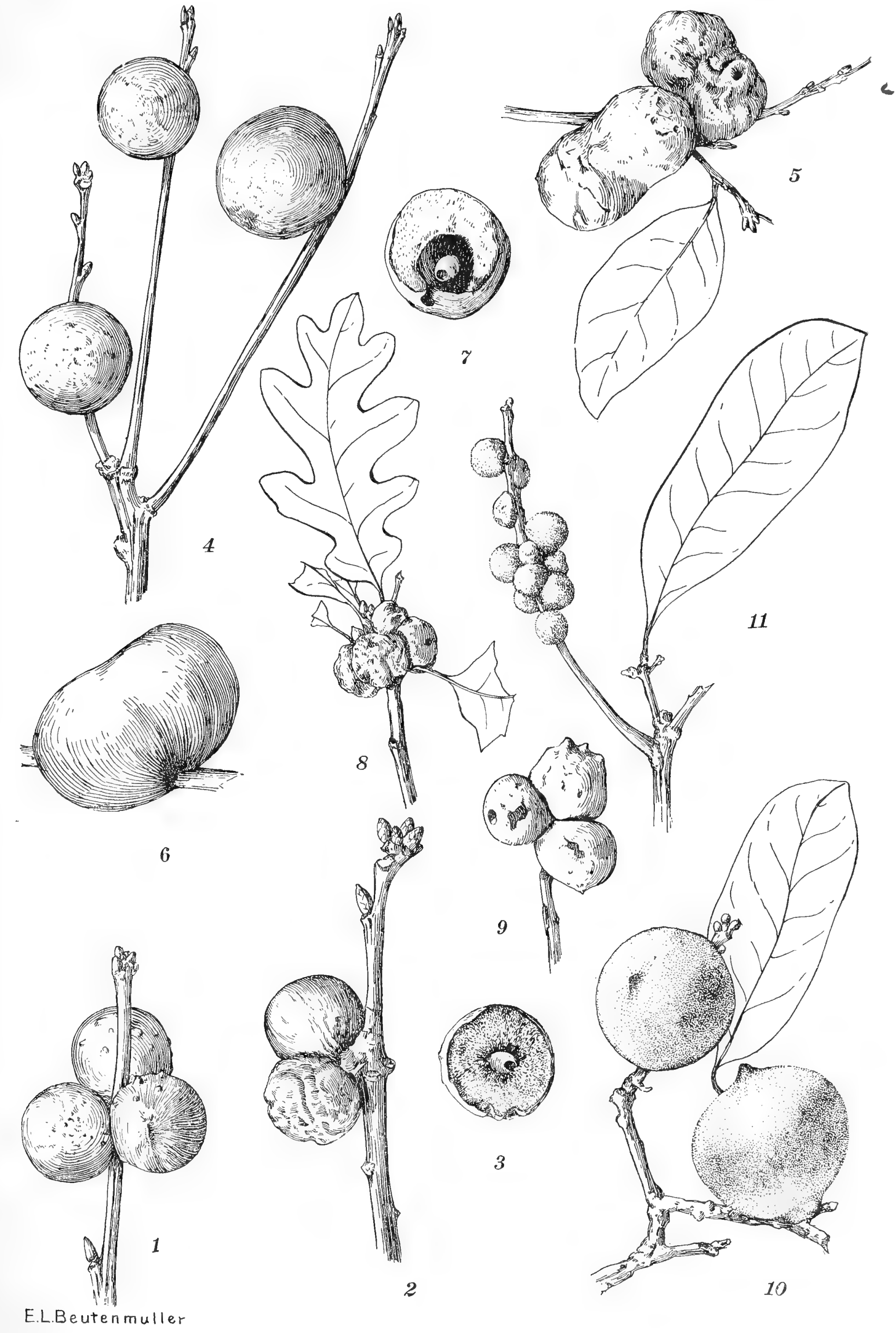
Plate VIII.

Fig.	1.	*Holcaspis*	*mamma* Walsh.
"	2.	"	*ficigera* Ashmead.
"	3.	"	*ficigera* Ashmead.
"	4.	"	*ficigera* Ashmead, single gall.
"	5.	"	*ficigera* Ashmead, inside view.
"	6.	"	*bassetti* Gillette.

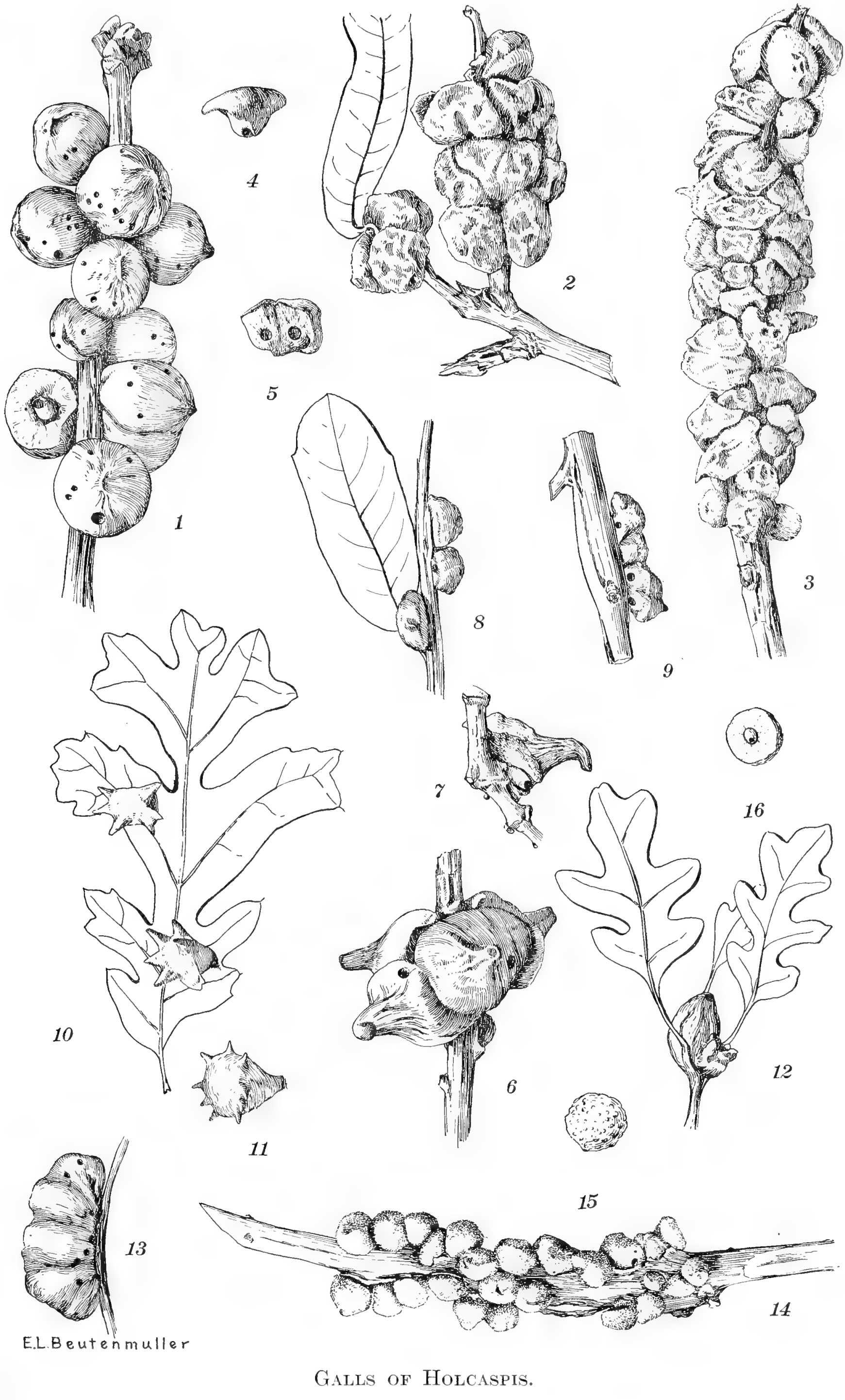
Fig.	7.	*Holcaspis*	*bassetti* Gillette, inside view.
"	8.	"	*chrysolepidis* Ashmead.
"	9.	"	*chrysolepidis* Ashmead, inside view.
"	10.	"	*douglasi* Ashmead.
"	11.	"	*douglasi* Ashmead.
"	12.	"	*sileri* Bassett.
"	13.	"	*truckeensis* Ashmead.
"	14.	"	*succinipes* Ashmead.
"	15.	"	*persimilis* Ashmead.
"	16.	"	*persimilis* Ashmead.

PLATE IX.

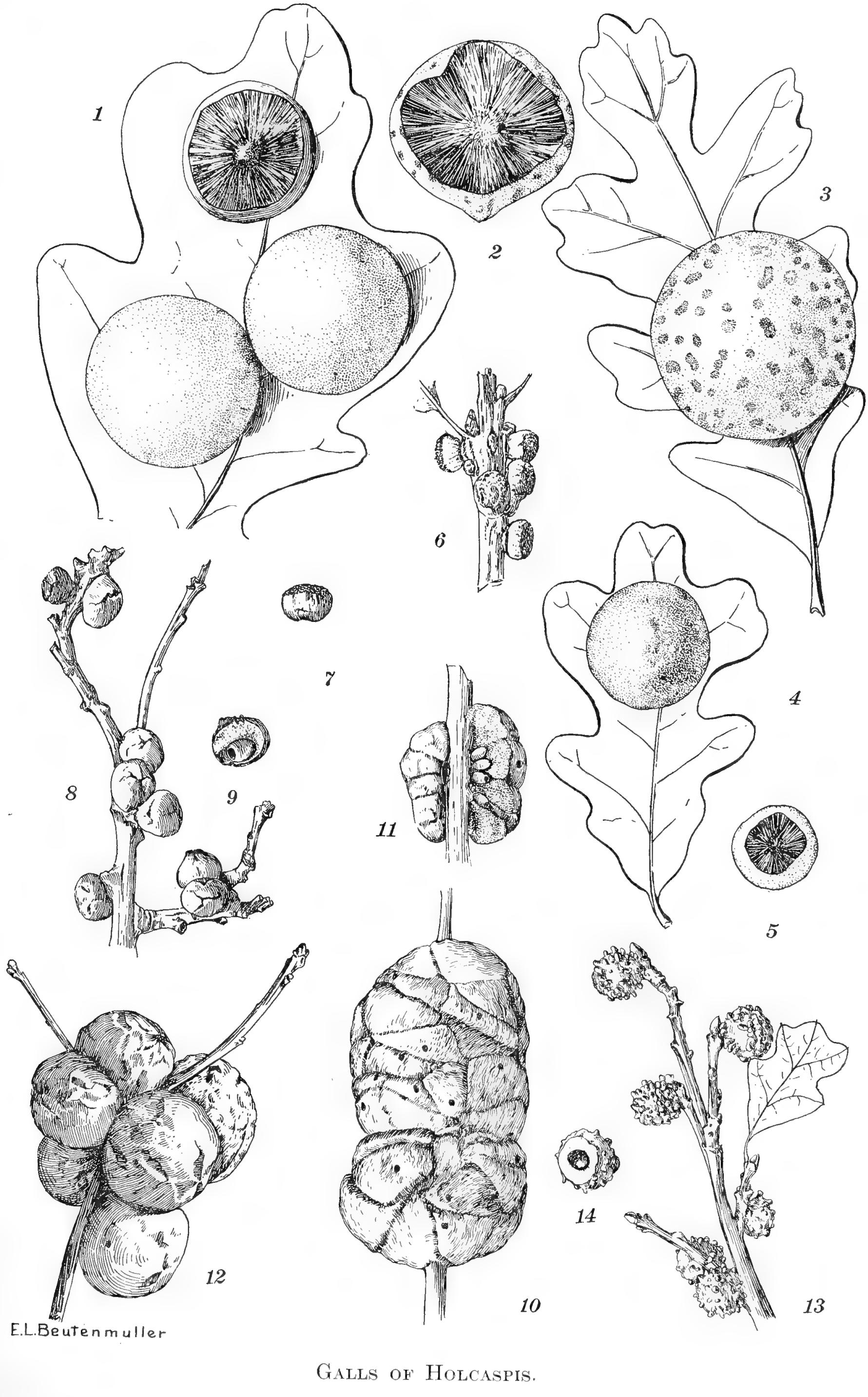
Fig.	1.	*Holcaspis*	*centricola* Osten Sacken.
"	2.	"	*maculipennis* Gillette, inside view.
"	3.	"	*maculipennis* Gillette.
"	4.	"	*brevipennata* Gillette.
"	5.	"	*brevipennata* Gillette, inside view.
"	6.	"	*eldoradensis*, sp. nov.
"	7.	"	*eldoradensis*, sp. nov. side view.
"	8.	"	*perniciosa* Bassett.
"	9.	"	*perniciosa*, inside view.
"	10.	"	*spongiosa* Karsch.
"	11.	"	*spongiosa* Karsch, inside view.
"	12.	"	*rugosa* Bassett.
"	13.	"	*corallina* Bassett.
"	14.	"	*corallina* Bassett, inside view.



GALLS OF HOLCASPIS.



GALLS OF HOLCASPIS.



GALLS OF HOLCASPIS.

59.57,92A

Article VI.— THE SPECIES OF *AMPHIBOLIPS* AND THEIR GALLS.

By William Beutenmüller.

Plates X–XV.

The genus *Amphibolips* seems to be confined to North America and contains the largest known species of Cynipidæ. The galls are also large and very characteristic, and these, together with the flies, are perhaps most suitable for experimental purposes. As is well known, galls from a botanical standpoint are of considerable scientific importance, in as far as their morphological structure and origin are concerned. The galls of Cynipidæ are not structureless growths and the histology of their structure and origin would prove an interesting study in itself. The origin and development of vegetable galls, particularly those occurring on the oak, is a study still in its infancy and not comprehensively understood. It was first considered by scientists that the female gall-producing Cynipid deposited simultaneously with its egg a drop of irritating liquid which caused the sap to flow, and that gall-formation was considered the result of chemical action upon the plant cells. This view, however, had to be abandoned, since it has been proved that the effect of the wound resulting from egg-laying is at once healed up, and that there is, according to the species, a considerable lapse of time from egg-deposition to hatching, and that no gall formation takes place before the hatching of the larvæ. It has been discovered by Adler that in two species of Cynipids (*Neuroterus lœviusculus* and *Trigonaspis crustalis*), gall formation commenced just as the larvæ were about to escape from the eggs, and the same observer found that as the larvæ grew and fed, so the gall increased in size.

Hence it may be inferred that gall formation is the result of the irritating action of the larva acting in conjunction with the vitality of the vegetable cells.

Another important question arises: What is the cause of the great variety of gall structure of the different species of Cynipidæ?

An important allusion to the way in which galls are developed upon plants is to be found in Weismann's 'Vorträge über Descendenztheorie,' Vol. II, 1902, p. 304. The following paragraph expresses his conception of the excitatory action of the larvæ of Cynipidæ upon the cells of the host plants. "Seidem Adler und Beyerlinck nachgewiesen haben, dass es nicht ein Gift des Mutterthiers ist, welches bei der Eiablage dem Blatt, oder

der Knospe u. s. w. eingeflösst wird, und welches nun den Reiz sur Gallenbildung setzt, ist die Sache um Einiges klarer geworden. Man kann sich nun vorstellen, dass verschiedene Reize nacheinander die die Larve einschliessenden Pflanzenzellen treffen, deren geordnete Aufeinanderfolge und genau abgestufte Reizwinkung die Zellen in verschiedener Weise zur Thätigkeit anregt, sei es zum blossen Wachsen und Sichvermehren in bestimmter Richtung, sei es zu Abscheidung von Gerbsäuren oder Holzstoff, oder Ablagerungen von Nährstoffen u. s. w. Schon allein die schwachen Bewegungen der jungen Larve werden einen solchen Reiz bilden, der sich mit ihrem Wachsthum verstärkt, dann vor Allem die Fressbewegungen, und schliesslich, und nicht zum geringsten, verschiedenartige Sekrete, welche das Thier durch seine Speicheldrüsen ausscheidet, und welche wohl irgend welche wirksame und vermuthlich zeitlich wechselnde Stoffe enthalten; alle diese Momente werden als spezifische Zellenreize nach dieser oder jener Richtung die Stoffwechsel — und Wachsthumsvorgänge der Zellen beeinflussen und verändern. Im Prinzip wenigstens, wenn auch nich im Einzelnen, verstehen wir so die Möglichkeit, wie durch geordnete Aufeinanderfolge und genaue Abwägung dieser verschiedenen Zellenreize der in der That wunderbare Bau der Gallen zu Stande kommt als das Produkt des direkten und einmaligen Einflusses des Gallinsektes auf den Pflanzentheil."

Dr. H. Adler, in his invaluable paper 'Uber den Generationswechsels der Eichen-Gallwespen,' pages 209–215 (Zeitsch. für Wissensch. Zoologie, XXXV, pp. 151–244), makes the following observations on gall-formations: "Bei den Gallenwespen wird ebenfalls erst durch die ausschlüpfende Larva die Galle erzeugt, wie sich unschwer nachweisen lässt. Bei den Zuchtversuchen wiederholt sich nämlich immer die Erscheinung, mögen die Wespen in Knospen oder in Blätter ihre Eier gelegt haben, dass nach dem Stich zunächst keine Reaktion des betreffenden Pflanzengewebes eintritt. Öffnet man die Knospen, in welche Eier gelegt sind, so findet sich im Innern der Knospe, abgesehen von dem feinen Stichkanal gar keine Veränderung, so lange die Larven noch nicht ausgeschlüpft sind. Bei den Blätter anstechenden Gallwespen lässt es sich noch leichter kontrolliren. Ist z. B. von *Spathegaster baccarum* ein Blatt angestochen, so sieht man deutlich die Stelle wo der Stachel eingedrungen ist, aber während der ersten 14 Tage tritt eine weitere Veränderung der Blattfläche nicht ein, sondern erst mit dem Ausschlüpfen der Larve. Unzweifelhaft wird bei dem Stechen gleichzeitig etwas Sekret der Giftdrüse in die Wunde gelangen, welches eben dem vom Stachel gemachten Schnitt in die Blattfläche verkleben soll; aber irgend einen Reiz auf die Zellenthätigkeit übt dieses Sekret nicht aus. Noch weit frappanter ist dieser Vorgang bei *Trigonaspis crustalis*; wenn von dieser Wespe im Mai Blätter angestochen worden

sind, so vergehen Monate, bevor eine Spur von Gallenbildung zu bemerken ist. Die Wespe schneidet mit ihrem ziemlich kräftigen Stachel in die Blattrippen hinein und hinterlässt dadurch eine deutliche Spur, wo ein Ei abgesetzt wurde. Man kann von dieser geführt leicht einige Eier aufsuchen; erst im September schlüpfen die Larven aus und dann beginnt die Gallenbildung. Natürlich wird es von Intresse sein, den Zeitpunkt wahrzunehmen, wo die Larve dem Ei entschlüpft und die Gallenbildung einleitet Leider ist dies recht schwierig. Mag das Ei in einer Knospe oder in einem Blatte eingeschlossen sein, stets ist es dem Blicke entzogen und es hält schwer den Moment abzupassen, wo die Larva ausschlüpft. Est ist mir gelungen einige Male bei *Neuroterus læviusculus* und *Biorhiza aptera* dieses Stadium zu beobachten. In dem Augenblicke nun, wo die Larve die Eihaut durchbrochen hat und zum ersten Male mit den feinen Kiefern die nächstgelegenen Zellen verwundet, beginnt eine rapide Zellenwucherung. Disselbe geht so rasch von statten, dass, während die Larve mit dem Hinterleibsende noch in der Eihaut steckt, vorn bereits eine wallartige Wucherung von Zellen sich erhebt. Man kann sich freilich diese schnelle Zellenvermehrung wohl erklären, weil der von der Larve ausgehende Reiz in höchsten Grade bildungsfähige Zellen trifft, die alle Bedingungen zu neuem Wachsthume in sich vereinigen."

Gall-formation may thus very properly be considered as a pathophysiological problem and a subject for the physiological botanist to investigate in its floral aspects in conjunction with such contributions as entomological study may furnish from the analysis and determination of the toxicology derived from the secretions, and perhaps characters of anatomical value of the larvæ.

Amphibolips *Reinhard.*

Cynips (in part) Harris, Rep. Ins. Mass., 1841, p. 398.

Callaspidia (in part) Fitch, 5th Rep. Ins. N. Y., 1859, p. 38.

Amphibolips Reinhard, Berlin, Ent. Zeit., Vol. IX, 1865, p. 10; Mayr, Gen. Gallenb. Cynip., 1881, p. 26; Cresson, Synop. Hymen. N. Am., pt. I, 1887, pp. 26, 31; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 62; Psyche, Vol. X, 1903, p. 154.

Head large. Antennæ in the female 12–14-jointed, in the male 15–16-jointed. Thorax very robust, wider than the head, highly convex and very coarsely rugose, scabrous or aciculated. Parapsidal grooves distinct or indistinct, being more or less obliterated by the rugosities or coarse sculpture. Scutellum subquadrate or cushion-shaped, a little wider than long, and sometimes emarginate at the tip, with the foveæ at the base very large, deep, and wrinkled. Abdomen smooth or punctured. Claws with a tooth at the base beneath. Wings hyaline with a fuliginous cloud, bands, or almost entirely fuliginous. Radial area open at the margin.

Type. *Cynips spongifica* O. S.

Amphibolips confluens (*Harris*).

Cynips confluens Harris, Rep. Ins. Mass. Inj. Veget., 1841, p. 397; Treat. Ins New Engl. Inj. Veget., 2nd edit., 1852, p. 433; Treat. Ins. Inj. Veget., 3rd edit., 1862, p. 546, pl. viii, figs. 9, 10 and figs. 253, 254; *ibid.*, Flint edit., 1862, p. 546, pl. viii, figs. 9, 10, and figs. 253, 254; *ibid.*, 1863; *ibid.*, 1880. Osten Sacken, Ent. Zeit. Stettin, 1861, pp. 405, 408, 410; Smith, Ent. Month. Mag., Vol. V, 1869, p. 298; Glover, Ill. N. Am. Ent., 1877; pl. viii, fig. 5; Rep. U. S. Com. Agricul., 1877 (1878), p. 94, pl. i, fig. 19.

Cynips aciculata Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1861, p. 56; *ibid.*, Vol. IV, 1865, pp. 341, 354; Reinhard, Berlin, Ent. Zeit., Vol. IX, 1865, p. 5; Smith, Ent, Month. Mag., Vol. V, 1869, p. 298; Provancher, Nat. Canad., Vol. XII, 1881, p. 232; Faun. Ent. Canad. Hymen., 1887, p. 176.

Cynips q. aciculata Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1862, pp. 245, 247; Bassett, Proc. Ent. Soc. Phila., Vol. II, 1863, p. 329; Walsh, Am. Ent., Vol. I, 1869, p. 103; *ibid.*, Vol. II, 1870, p. 330.

Cynips quercus aciculata Walsh, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 443.

Amphibolips aciculata Mayr, Gen. Gallenb. Cynip., 1881, p. 27; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 251; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 103.

Andricus confluens Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 295.

Amphibolips confluens Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 127; Bull. I, Col. Biol. Assoc., 1890, p. 38; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Bridwell, Trans. Kans. Acad. Sci., Vol. XVI, 1899, p. 203; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67; Beutenmüller, Psyche, Vol. XV, 1908, p. 10.

Amphibolips confluentus Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 250, pl. x, fig. 4; Am. Mus. Journ., Vol. IV, 1904, p. 96, fig. 14; Ins. Galls, Vicin. N. Y., 1904, p. 10, fig. 14; Cook, 29th Rep Dept. Geol. Nat. Hist. Indiana, 1904 (1905), p. 822, fig. 16; Felt, Ins. Affect. Park and Woodl. Trees, Vol. II, 1906, p. 625.

Amphibolips confluentis Jarvis, Rep. Ent. Soc. Ont., 1906 (1907), p. 70, pl. D, fig. 2.

Agamous female. Head black, rugose, face with fan-shaped aciculations. Antennæ black, or somewhat piceous, 13-jointed. Thorax finely rugose, with many longitudinal aciculations. Parapsidal grooves very indistinct, but traceable. Anterior parallel lines fine, rather widely separated. Median groove present, rather flat and not distinct. Pleuræ rugose with dense longitudinal grooves or aciculations. Scutellum transverse, coarsely rugose, truncately rounded at the tip. Foveæ large, distinct. Abdomen glossy, pitchy black and microscopically punctate. Legs reddish brown pubescent. Wings hyaline, with a large brown patch in the radial area, which is open at the costal margin. Areolet large, triangular. Length, 4 to 6 mm.

Amphibolips confluens form **spongifica** (*Osten Sacken*).

Cynips confluens Osten Sacken (non Harris), Proc. Ent. Soc. Phila., Vol. I, 1861, p. 56.

Cynips q. coccinea Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1862, pp. 243, 247; *ibid.*, Vol. IV, 1865, pp. 344, 347.

Cynips quercus coccinea WALSH, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 445.

Amphibolips cocciniæ ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294.

Amphibolips coccinea ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 303; *ibid.*, Vol. XIV, 1887, p. 127; GILLETTE, 27th Rep. Agricul. Mich., 1888, p. 467; Psyche, Vol. V, 1889, p. 183; Proc. Iowa Acad. Sci., Vol. I, 1892, p. 110; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 104; BRIDWELL, Trans. Kans. Acad. Sci., Vol. XVI, 1899, p. 203; DALLE TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Cynips q. spongifica OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. I, 1862, p. 244, 247; WALSH, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 447, 481; Am. Ent., Vol. I, 1869, p. 103; *ibid.*, Vol. II, 1870, p. 331; PACKARD, 5th Rep. U. S. Ent. Com., 1890, p. 115.

Cynips spongifica OSTEN SACKEN, Proc. Ent. Soc. Phila , Vol. IV, 1865, pp. 340, 344, 347, 354.

Cynips quercus spongifica RILEY 1st, Rep. Nox. Ins. Missouri, 1869, p. 14; SMITH, Trans. Ent. Soc. Lond., 1869, p. xi; CAMERON, Proc. Nat. Hist. Soc. Glasgow, Vol. III, 1876, p. 110.

Amphibolips spongifica REINHARD, Berlin, Ent. Zeit., Vol. V, 1865, p. 10; MAYR, Gen. Gallenb. Cynip., 1881, p. 27; ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 294, 304; *ibid.*, Vol. XIV, 1889, p. 127; Bull. No. 1, Colorado Biol. Assoc., 1890, p. 38; GILLETTE, 27th Rep. Agricul. Mich., 1888, p. 468; Psyche, Vol. V, 1889, p. 184; BEUTENMÜLLER, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 251; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 106; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Female. Head black, rugose, with a few scattered hairs. Antennæ 13-jointed, black or piceous, basal joints rufous. Thorax dark rufous, coarsely and irregularly rugose, transversely wrinkled at the sides, and not aciculated as in the dimorphic female, *A. confluens.* Parapsidal grooves continuous, broad, distinct and dilating at the scutellum. Median groove rather distinct and broad. Anterior parallel line very narrow and indistinct. Pleuræ rugose. Scutellum coarsely rugose, dark rufous, rather strongly emarginate at the tip. Foveæ very large. Abdomen red, shining and microscopically punctate. Legs amber yellow, pubescent. Wings pale yellowish hyaline with a large smoky brown patch at the base of the radial cell. Length 3.50 to 5 mm.

Male. Head, thorax and scutellum black with the sculpturing like that in the female. Antennæ 15-jointed, abdomen varying from red to almost black. Otherwise as in the female. Length 3 to 3.50 mm.

Gall. (Plate X, Fig. 1; Plate XI, Figs. 1, 2.) On the leaves usually from a vein or the petiole on red oak (*Quercus rubra*), scarlet oak (*Quercus coccinea*), quercitron or yellow oak (*Quercus velutina*) in May and June. Globular or nearly so, smooth, shining or opaque with a thin outer shell. Internally filled with a juicy white spongy substance and with a large, hard, central larval cell. When fresh the gall is green, and light brown when old and dry, with the internal spongy substance dark brown. Diameter, 25 to 50 mm.

Habitat: Canada; New England and Middle States, south to Georgia and west to Colorado.

This well-known gall is very common and hundreds may be often found upon a single tree. It makes its appearance early in May, as soon as the

leaves put forth, on different kinds of oaks belonging to the red oak group, and is fully grown in a few weeks. It is popularly known as "oak-apple" or May-apple, owing to its superficial resemblance to a small apple. From a certain number of the galls emerge, by the middle of June, both male and female gall flies. These have been named by Osten Sacken, *Cynips (Amphibolips) spongifica.* The gall-flies which emerge in October or the following spring are all agamous females, and have been named *Cynips confluens* by Harris. I have examined the type of *confluens* in the Boston Society of Natural History, and find it to be identical with *Amphibolips aciculata* Osten Sacken. *Amphibolips coccinea* occurs on the scarlet oak, and is the same as *spongifica,* which is found on the red oak (*Quercus rubra*) and quercitron oak (*Quercus velutina*). According to Walsh (Am. Ent., Vol. I, 1869, p. 103), *A. confluens* (= *aciculata*) is the dimorphic female of *A. spongifica.* He informs us that by the fore part or middle of June both male and female gall-flies of *A. spongifica* eat their way out of a certain percentage of galls while the larvæ of others lie dormant for more than two months, when they change into pupæ state, and subsequently about October eat their way out in the form of gall-flies known as *Amphibolips confluens.* Out of thousands of these autumnal flies examined by Walsh, all were females with not a single male among them. He has experimentally ascertained, by colonizing a number of these females upon isolated black oaks (*Q. velutina*) known to be not previously infested with oak-apples, that they cause galls to be generated in the following spring upon such isolated black oaks. From galls produced in this manner, Walsh succeeded in breeding two specimens of the spring form of gall-flies (*A. spongifica*), which exists in both sexes, and five specimens of the autumnal form (*A. confluens*), which exists exclusively in the female sex. Finally, he treated these five autumnal specimens in the same manner, *i. e.,* placing them upon another isolated black oak, and obtained galls in the following spring which produced two specimens of the spring form (*spongifica*), proving that the autumnal form sooner or later reverts to the spring form.

The types of *A. confluens* are in the Boston Society of Natural History and *A. aciculata* and *spongifica* are in the Museum of Comparative Zoölogy.

Amphibolips caroliniensis *Bassett.*

Amphibolips caroliniensis Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 85, Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 104; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Female. Head and thorax black. Parapsidal grooves scarcely recognizable in the coarse sculpturing of the thorax. Abdomen reddish brown with the second segment shorter than in *A. spongifica.* Legs dark reddish brown. Wings dusky hyaline

with the first cross-vein more distinctly defined than in *spongifica*, and the dark cloud in the base of the open radial area smaller and not involving the small areolet, though reaching quite to it on the anterior side. Claws two toothed. Length, 5.50 mm.

Gall. (Plate XI, Fig. 3.) Attached to the midrib near the base of a leaf and prevents its development beyond the point of attachment. It occurs on a species of oak probably, *Quercus minor*. Resembles the galls of *Amphibolips spongifica* and *Amphibolips cinerea*, but the surface is more coarsely reticulated and less glossy. Internally the spongy mass surrounding the larval cell is of a much darker color. The outer shell is thinner and in dried specimens is irregularly shrunken and depressed.

Habitat: North Carolina (Statesville).

The type of the adult is in the American Entomological Society and the gall in the American Museum of Natural History. The gall very much resembles that of *Amphibolips longicornis*.

Amphibolips longicornis *Bassett.*

Amphibolips longicornis Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 321; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Male. Head small, black, and corrugated, shining. Antennæ dull brown, 15-jointed, first and second equal, very short, second globular, third one and one half times as long as the first two, fourth three-fourths as long as the third, fifth and following scarcely shorter than the fourth. Thorax black, roughly ridged longitudinally. Parapsidal grooves indistinct in the coarse corrupations. Scutellum very short and broad, with two prominent carinæ dividing the dorsal surface into three equal coarsely wrinkled parts. Foveæ large, round, deep and smooth. Abdomen small, black, smooth. Wings pale brown, veins distinct, with a reddish brown cloud on the small areolet and at the base of the radial area. Cubitus continuous. Length 4 mm.

Gall. Allied to *A. spongifica*, and probably found in similar situations on the leaves and young twigs of oak. Monothalamous and very thin shelled. Internally it is of a soft, light and spongy consistency not unlike that of *A. spongifica.* Length 35 mm. Width 30 mm.

Habitat: Texas (Palestine).

The species of oak upon which the galls of this species occur is not known. The type galls are in a very poor condition and the fly is only known by a single specimen. The types are with the American Entomological Society, and a cotype gall in the American Museum of Natural History.

Amphibolips acuminata *Ashmead.*

Amphibolips acuminata Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 127; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Female. Closely allied to *Amphibolips spongifica.* In color and stature it is like *spongifica*, but the sculpture is more coarsely rugose, the parapsidal grooves distinct, and the hind legs are black. Length, 5 mm.

Gall. (Plate XI, Figs. 4, 5.) Attached to the twigs of black jack oak (*Quercu marylandica*) in May and June. Elongated, subglobular, sometimes pepper-shaped, with the apex drawn out into a point, which is sometimes bent. Yellowish brown, probably green when fresh, thin shelled as in *Amphibolips confluens* and smooth. Internally it is filled with a spongy substance, with a central, hard, larval cell. Length, 30 to 55 mm. Diameter 15 to 30 mm.

Habitat: Maryland; Virginia.

The types are in the United States National Museum.

Amphibolips inanis (*Osten Sacken*).

Callaspidia confluenta Fitch (non Harris), 5th Rep. Nox. Ins. N. Y., 1859, (Trans. N. Y. Agricul. Soc., 1858 (1859), p. 817.

Cynips q. inanis Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1862, pp. 242, 247; Walsh, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 481; Am. Ent. Vol. I, 1869, p. 104, fig. 79; *ibid.*, Vol. II, 1870, p. 331.

Cynips inanis Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 344, 347, 354.

Amphibolips inanis Mayr, Gen. Gallenb. Cynip., 1881, p. 27; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294; *ibid.*, Vol. XIV, 1887, p. 127; Gillette, 27th Rep. Agricul. Mich., 1888, p. 468; Psyche, Vol. V, 1889, p. 184; Proc. Iowa Acad. Sci., Vol. I, pt. II, 1892, p. 111; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 251, pl. x, fig. 5; Am. Mus. Journ., Vol. IV, 1904, p. 97, fig. 15; Ins. Galls Vicin. N. Y., 1904, p. 11, fig. 15; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67; Cook, 29th Rep. Dept. Geol. Nat. Hist. Indiana, 1904 (1905), p. 823, fig. 17; Felt, Ins. Affect. Park and Wood. Trees, Vol. II, 1906, p. 625; Jarvis, Rep. Ent. Soc. Ont., 1907 (1908), p. 90.

Amphibolips inanus Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 303.

Male and Female. Head deeply black and rugose. Antennæ of the female 13–14-jointed, dark brown, basal joints and terminal joint reddish; 15-jointed in the male, reddish brown or wholly black and longer than in the female. Thorax very coarsely black, or somewhat rufous, very coarsely and deeply, irregularly rugose, with a rugose median groove and the anterior parallel lines visible. Parapsidal grooves almost lost in the rugose surface, but traceable toward the scutellum. Pleuræ rugose. Scutellum very rugose, somewhat emarginate at the tip. Foveæ large, shining with transverse wrinkles. Abdomen reddish, shining. Legs yellowish brown, posterior tibiæ and tarsi sometimes infuscated. Wings hyaline with a large brown patch at the base of the radial area, and slightly extending over the second cross-vein. Length of male 3 to 4 mm.; of female 4 to 4.5 mm.

Gall. (Plate XI, Figs. 6, 7.) On the leaves of scarlet and red oak (*Quercus coccinea* and *Quercus rubra*) in May and June. Bright green, sometimes with darker spots. Globular or nearly so, sometimes with a small nipple at the apex, thin shelled, with the surface glossy. Inside with a larval cell held in position by thread-like white filaments. When dry the gall becomes yellowish brown, often with darker brown patches. It is then very thin shelled and brittle. Diameter 25 to 35 mm.

Habitat: Canada; New England and Middle States; Maryland; Virginia; North Carolina; Ohio; Michigan; Indiana; Iowa.

Externally the gall may be mistaken for that of *Amphibolips confluens*, but it is as a rule smaller and the larval cell is held in position by radiating fibres while the galls of *confluens* are filled completely with a dense spongy substance. The adults emerge in June and early in July. The types are in the Museum of Comparative Zoölogy. Two cotypes of the galls are also in the American Museum of Natural History.

Amphibolips ilicifoliæ (*Bassett*).

Cynips q. ilicifoliæ Bassett, Proc. Ent. Soc. Phila., Vol. III, 1864, p. 682; Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 344, 348.

Cynips ilicifoliæ Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 340, 355.

Amphibolips ilicifoliæ Mayr, Gen. Gallenb. Cynip., 1881, p. 27; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 294, 304; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 252, pl. x, fig. 6; Am. Mus. Journ., Vol. IV, 1904, p. 97, fig. 16; Ins. Galls Vicin. N. Y., 1904, p. 11, fig. 16; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 104; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67; Felt, Ins. Affect. Park and Wood. Trees, Vol. II, 1906, p. 625.

Female. Head black with the vertex irregularly sculptured, face rugose and pubescent, the hairs converging toward the mouth; palpi shining red. Antennæ 13-jointed, first and second joints very short, shining black, remaining joint dull black and pubescent. Thorax deeply and irregularly sculptured, with a short pubescence, grooves obliterated by the coarse, somewhat linearly arranged sculpturing. Scutellum very rugose with large foveæ. Abdomen shining black, ventral edge clear reddish brown, the segments, except the first and second, with very fine microscopic punctures. Legs: anterior and middle pair reddish brown with the upper parts of the femora and coxæ black; posterior legs black, reddish at the joints. Wings pale dusky, hyaline, veins brownish black, vein at base of the open radial area, covered by a large brownish black cloud, which covers part of the areolet, but does not reach the anterior margin of the wing. In some examples there is a very pale brown cloud in the basal cell. Areolet very small. Length 4.25 mm.

Male. Similar to the female, but with 15-jointed antennæ, and darker legs, the posterior pair almost entirely black. Length 3.50 mm.

Gall. (Plate XII, Figs. 5, 6.) On the upper side of the leaves of scrub oak (*Quercus nana*), standing erect or nearly so, sometimes entirely preventing the development of the leaf and apparently growing out of the petiole. Dark green, elongated, fusiform with the apex rather longer and more slender than the basal portion, and often curved. The outer shell is thin, smooth, and opaque. Internally with a larval cell held in position by radiating fibres as in *Amphibolips inanis*. Length 25 to 55 mm.; width 7 to 20 mm.

Habitat: Connecticut; New York; New Jersey; Pennsylvania; Delaware; Maryland.

The galls may be found in May and June and the adults emerge during the latter month. The types are in the American Entomological Society and type galls in the American Museum of Natural History.

Amphibolips coelebs (*Osten Sacken*).

Cynips quercus coelebs Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1861, p. 60; Ent. Zeit. Stettin, Vol. XII, 1861, pp. 408, 411.

Cynips coelebs Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 340, 345, 348, 355.

Amphibolips coelebs Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 294, 304; *ibid.*, Vol. XIV, p. 128; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67; Beutenmüller, Am. Mus. Journ., Vol. IV, 1904, p. 98, fig. 17. Ins. Galls Vicin. N. Y., 1904, p. 12, fig. 17.

Amphibolips caelebs Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 104.

Male. Head and thorax black, coarsely rugose, somewhat pubescent. Antennæ 15-jointed, reddish brown, paler toward the tip, about as long as the body. Abdomen reddish brown. Legs rusty yellow, posterior femora and tibiæ infuscated. Wings hyaline with a brown spot on the second cross-vein and a pale almost obsolete brownish shade between it and the anal angle of the wing, radial area open, second cross-vein stout and angular. Areolet very small and indistinct. Length 4 mm.

Gall. (Plate XI, Figs. 8, 9, 10.) On the edge of a leaf of scarlet oak (*Quercus coccinea*) and red oak (*Quercus rubra*). Sometimes also found on young and tender twigs. Elongated or fusiform, narrow, with the apex prolonged into a point; base usually with a long pedicel, inserted on the edge of the leaf and being the prolongation of the leaf-vein. Pale green with a thin outer shell. Internally there is an oblong thin larval cell, held in position by radiating fibres. Length 20 to 25 mm.; width 4 to 8 mm.

Habitat: New York, New Jersey, Washington, D. C.

The fly is known only by a single male. The type, together with the gall, are in the Museum of Comparative Zoölogy. Several galls taken on *Quercus coccinea* by Mr. W. T. Davis and myself are in the American Museum of Natural History. The gall makes its appearance from about the middle of May to early in June, and the adult emerges during the latter month. It is allied to *Amphibolips inanis,* but differs by having a less distinct areolet and paler legs. The gall is somewhat similar to those of *Amphibolips citriformis* and *Amphibolips ilicifoliæ.*

Amphibolips citriformis (*Ashmead*).

Cynips q. citriformis Ashmead, Trans. Am. Ent. Soc., Vol. IX, 1881, p. xxviii.

Amphibolips citriformis Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 294, 303; *ibid.*, Vol. XIV, 1887, p. 130; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 104; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Female. Head and thorax brownish black, deeply and coarsely punctate, slightly pubescent; palpi brownish. Antennæ reddish brown, 13-jointed. Parapsidal grooves indistinct, lines obsolete. Scutellum rounded, rugoso-punctate and somewhat pubescent. Foveæ distinct. Pleuræ rugose. Abdomen bright, reddish brown, shining, minutely punctate with a few hairs at the base of the second segment.

Legs reddish brown, posterior pair somewhat darker, pubescent. Wings hyaline, veins yellowish, radial area open, a dark brown spot extending across the base from tip of subcostal vein, basal vein thick, along subcostal for a short distance dark brown, areolet closed, petiolated. Length 5 mm.

Gall. (Plate XIII, Figs. 6–10). On the twigs of willow oak (*Quercus phellos*). Varying considerably in shape from narrow spindle shaped to globular, with the apex attenuated to a sharp point. Smooth, shining, yellowish, and rather thin shelled. Internally is a larval cell held in position by a few thin, radiating filaments. Length 12 to 24 mm.; width 6 to 12 mm.

Habitat: Florida.

The types of the fly and galls of this species are in the United States National Museum, and cotype galls in the American Museum of Natural History.

Amphibolips melanocera *Ashmead.*

Amphibolips melanocera Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 299, 303; *ibid.*, Vol. XIV, 1887, p. 130; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Male and Female. Head, antennæ and thorax black, abdomen shining reddish brown. Anterior and middle legs pale yellowish brown, femora to near the tip; hind legs dark brown or nearly black with the knees yellowish brown; all the coxæ black. Head rugoso-punctate. Antennæ 14-jointed in the male, 13-jointed in the female. Thorax coarsely rugose with some raised irregular markings, anterior parallel lines present, rather short, a rugose median groove and the parapsidal grooves lost in the coarse surface anteriorly, and traceable posteriorly. Pleuræ rugose. Scutellum rugose, with the foveæ at base transversely wrinkled, scarcely emarginate at the tip. Wings hyaline, veins dark, and a large brown patch at the base of the radius with a pale center. Length 4.50 to 5 mm.

Gall. (Plate XII, Figs. 1–4.) Issuing from the bud axilis of water oak (*Quercus nigra*). Globular or elongate oval, sometimes with a very short nipple at the apex. Greenish brown and yellowish green when fresh. Coffee brown and very glossy when dry. The outer shell is very thin, and internally there is a central kernel held in place by some very thin hair-like filaments. When dry the gall is very brittle, and may be easily crushed with the fingers. Diameter 7–15 mm.

Habitat: Florida.

This species resembles *Amphibolips citriformis*, but is easily distinguished by its dark antennæ and dark posterior legs. The gall is constructed on the same plan as in that species but is rounded or elongate oval and without a long pointed terminal prolongation at the apex.

The types are in the United States National Museum and a number of co-type galls are in the American Museum of Natural History.

Amphibolips cinerea (*Ashmead*).

Cynips q. cinerea Ashmead, Trans. Am. Ent. Soc., Vol. IX, 1881, p. xix.

Amphibolips cinerea Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 294, 303; *ibid.*, Vol. XIV, 1887, p. 294; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 104; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Female. Head brown, small, slightly pubescent, coarsely rugose; eyes brown, mandibles black. Antennæ 13-jointed, short, not reaching back of the scutellum. Thorax brown, broad, robust and convex; very coarsely rugoso-punctate. Parapsidal grooves almost obsolete. Anterior lines widely separated and almost parallel, indicated by coarse punctures. A deep transverse furrow dividing the mesothorax from the scutellum. A few microscopical whitish hairs toward the head, disc free. Scutellum round, elevated, deeply irregularly, rugoso-punctate. Foveæ deep, round, not quite separated. Pluræ rugoso-punctate, pubescent. Abdomen bright, reddish brown, smooth, very minutely punctate under a high power lens, globular and regularly rounded posteriorly, a high ridge at base of second segment, ventral sheath not projecting. Venter hairy the whole length. Legs reddish brown. Wings hyaline, rather hairy, veins reddish, a large brown patch at the base of the radial area and apical third of the areolet, also extending slightly along the cubitus. Basal vein thick and clouded. Anal vein brown from opposite the tip of the areolet; tip of radial vein pale; subcostal vein becomes brown as it approaches the basal vein and becomes pale again just before joining the large brown patch. Length 5 mm.

Gall. (Plate XII, Figs. 7–10.) Attached to the twigs and limbs of blue-jack or upland willow oak (*Quercus brevifolia*). Large, spherical or elongate oval, with a small nipple at the apex and of a dark crimson, mottled with small spots of a lighter color. The outer shell is rather thick, and when old it is brown, hard and brittle. Internally there is a central larval cell held in position by very dense brownish, spongy filaments. Length 24 to 35 mm.; width 20 to 30 mm.

Habitat: Florida.

The types are in the United States National Museum.

Amphibolips cooki *Gillette.*

Amphibolips cookii Gillette, 27th Rep. Agricul. Mich., 1888, p. 495, fig. 6; Psyche, Vol. V, 1889, p. 220, fig. 6; Proc. Iowa Acad. Sci., Vol. I, 1890, p. 56; *ibid.*, pt. II, 1892, p. 110; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 104.

Amphibolips cooki Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Female. Head black, face rugoso-aciculate, the furrows spreading out like a fan from either side of the clypeus; vertex and sides coarsely rugose. Antennæ 13-jointed. Thorax black and rather closely aciculated. Parapsidal grooves indistinct, and scarcely traceable. Anterior parallel lines very indistinct. Pleuræ finely and obliquely aciculated. Scutellum coarsely rugose, with the foveæ large, deep and shining. Abdomen dark reddish brown to almost black, smooth and shining, and exceedingly minutely punctate. Legs dark reddish brown, pubescent; coxæ blackish. Wings slightly dusky, hyaline, with a large dark brown patch at the base of the radial cell. Length 5.50 mm.

Gall. (Plate XIII, Figs. 1–5.) Issuing from a bud on the terminal twigs of red oak (*Quercus rubra*) in September and October. Almost globular and usually with a small nipple at the apex. Green and succulent and spotted with red when fresh, and with the outer shell moderately thick. Internally with a central larval cell held in position by radiating fibres. When old the gall becomes brown and shriveled in appearance. Diameter about 16 to 18 mm.

Habitat: Connecticut; New York; New Jersey; North Carolina (Black Mts.); Pennsylvania; Michigan; Iowa.

The gall somewhat resembles that of a *inanis*, but differs by being smaller, a thicker outer shell and much stouter radiating fibres. It is an autumnal species and the galls readily break off when touched, or it falls with the leaves or before them. It is a bud gall, while that of *A. inanis* occurs on the leaves in spring. The adult emerges late in August and early in September. The types are in the Iowa Agricultural College, and the adult was kindly sent to me for examination by Prof. H. E. Summers. Cotypes of the galls from Prof. C. P. Gillette are in the American Museum of Natural History.

Amphibolips tinctoriæ *Ashmead.*

Amphibolips tinctoriæ Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 125; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Female. Head black rugose. Antennæ 13-jointed, dark brown. Thorax striate-rugose more or less distinctly striated; the striæ are sometimes oblique and irregular. Parapsidal grooves obliterated, or only slightly indicated anteriorly. Scutellum coarsely rugose with the foveæ large, deep and separated by a carina. Pleuræ rugose, usually pubescent and sometimes with a raised polished area. Abdomen black, dark brown beneath, and margins of second and following segments brown. Legs reddish yellow. Wings hyaline, veins distinct, dark brown, first cross-vein angulated and enclosed in a brown patch. Areolate large. Length 4.6 to 5 mm.

Gall. (Plate XIV, Figs. 1, 2.) Issuing from a bud on quercitron or yellow oak (*Quercus velutina*) and red oak (*Quercus rubra*) in autumn. Almond-shaped, acuminate, at tip, compressed with the opposite sides keeled. Green or red when fresh and brown when old. Rather thick shelled and smooth. Internally it is hollow with a central larval cell held in position by radiating fibres. Length 12 to 20 mm.

Habitat. Connecticut; New Jersey; Pennsylvania.

Allied to *Amphibolips spongifica*, but the peculiar striated rugose thorax readily distinguishes it from that species. The gall is a deformation of a bud and the characteristic keel shaped sides and compressed form, separates it at once from all other known galls of *Amphibolips.* The types are in the United States National Museum, and specimens of the gall are in the American Museum of Natural History.

Amphibolips spinosa *Ashmead.*

Amphibolips spinosa Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, pp. 127, 141; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Female. Reddish brown, finely and sparsely pubescent, and closely allied to *Amphibolips citriformis.* The legs are more densely pubescent and the head and thorax less coarsely rugose. The basal vein of the wing, tip of submarginal vein

and the cloud at base of radius are distinctly black. The areolet is smaller than in *A. citriformis*. Length 4.50 mm.

Gall. On leaves of laurel oak (*Quercus laurifolia*). Brown, globular, covered with prickles or spines. The outer shell is thick and internally it is composed of a slight spongy substance, which surrounds the thin central larval cell. Diameter 7.50 mm.

Habitat: Florida.

The types are in the United States National Museum.

Amphibolips globulus sp. nov.

Female. Head black finely and rather evenly rugoso-punctate. Thorax black, large, finely and evenly rugose, almost granulose. Parapsidal and median grooves distinct from the scutellum to about the middle, thence obliterated. Anterior parallel lines, fine and widely separated. Grooves at base of wings distinct, but not prominent. Scutellum black, more roughly rugose than the thorax, distinctly emarginate at the tip. Foveæ large and wrinkled. Abdomen dark reddish brown, smooth and polished. Legs reddish brown. Wings hyaline with a dark brown patch at the base of the radial area. Areolet large and brown. Length 6 mm.

Gall. (Plate XIV, Figs. 3, 4, 5.) On the twigs of black jack oak (*Quercus marylandica*) in September. Globular, thick shelled, with a small nipple at the apex. Filled with a very dense mass of radiating spongy substance. Green when fresh, brown when dry. Diameter 14 to 17 mm.

Habitat; Lakehurst, New Jersey.

The gall very much resembles that of *Holcaspis globulus* externally, but the internal structure is very different. The types are in the American Museum of Natural History.

Amphibolips nubilipennis (*Harris*).

Cynips nubilipennis Harris, Rep. Ins. Mass. Inj. Veget., 1841, p. 399; Treat. Ins. New Engl. Inj. Veget. 2nd edit., 1852, p. 434; Treat. Ins. Inj. Veget. 3d edit., 1862, p. 548; *ibid.*, Flint edit., 1862, p. 548; *ibid.*, 1863, p. 548; *ibid.*, 1880, p. 548; Osten Sacken, Ent. Zeit. Stettin, 1861, pp. 409, 412; Proc. Ent. Soc. Phila., Vol. I, 1861, p. 63; Walsh, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 484.

Callaspidea nubilipennis Fitch, 5th Rep. Ins. N. Y. 1859 (Trans. N. Y. Agricul. Soc., 1858 (1859), p. 818).

Amphibolips nubilipennis Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 294, 304, *ibid.*, Vol. XIV, 1887, p. 128; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Beutenmüller, Psyche, Vol. XV, 1908, p. 10.

Cynips quercus sculptus Bassett, Proc. Ent. Soc. Phila., Vol. II, 1863, p. 324;

Cynips quercus sculpta Walsh, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 484.

Cynips sculpta Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 347, 356.

Cynips q. sculpta Packard, 5th Rep. U. S. Ent. Com., 1890, p. 114.

Amphibolips sculpta Mayr, Gen. Gallenb. Cynip., 1881, p. 27; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp. 294, 304; *ibid.*, Vol. XIV, 1887, p. 127; Gillette,

27th Rep. Agricul. Mich., 1888, p. 468; Psyche, Vol. V, 1889, p. 184; Proc. Iowa Acad. Sci., Vol. I, 1892, p. 111; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Cook, 29th Rep. Dept. Geol. Nat. Hist. Indiana, 1904 (1905), p. 825; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Female. Head black, irregularly and coarsely rugose. Antennæ 13-jointed, black, piceous or very dark rufous. Thorax black coarsely and irregularly sculptured. Parapsidal grooves continuous, rugose, widely separated at the collar and converging toward the scutellum where they are not widely separated. Anterior parallel lines exceedingly fine and scarcely visible on the rugose surface. From the scutellum to the collar there is a rather broad, rugose median groove. Pleuræ finely and evenly rugose. Scutellum rugose, broadly emarginate posteriorly. Foveæ very large occupying about one half of the scutellum, somewhat shining and transversely wrinkled. Abdomen varying from rufous to piceous microscopically punctate, except at the smooth base. Legs yellowish brown, coxae piceous. Wings hyaline with a brown cloud from the second cross-vein to the tip of the wing, veins rather delicate. Areolet triangular. Length 2.50 to 3.50 mm.

Male. Head, thorax and scutellum similar to that of the female, black. Antennæ 15-jointed and longer than the female, rufous. Abdomen polished with the punctation exceedingly minute and not visible without a strong lens. Wings evenly hyaline, without and dark cloud, veins very delicate. Legs yellowish brown. Length 2.50 to 3 mm.

Gall. (Plate XIV, Figs. 8–10.) Attached to the under side of leaves of red oak (*Quercus rubra*), and scarlet oak (*Quercus coccinea*). Globular or oblong oval and the color of a green grape sometimes with a tinge of pink, succulent and translucent. Internally there is a single cell which can be seen when held up to the sunlight, Diameter 6 to 18 mm.

Habitat: New York; New Jersey; Connecticut; Massachusetts; Pennsylvania; Michigan; Iowa; Indiana; Illinois.

The galls of this distinct species may be found fully developed from about the middle of June to early in July, the fly appearing during the latter month.

The gall when fresh is almost exactly like a green grape and is sometimes partly or wholly pinkish. It is juicy and soft with a hard central larval cell.

When dry the gall is shriveled, and very distorted in shape. It is then hard and woody and contains a rounded larval cell in surrounding substance. I have examined Harris' types of the fly and galls and found them to be identical with the types of *Amphibolips sculptus* Bassett. The types of *A. nubilipennis* are in the Boston Society of Natural History, and the types of *A. sculptus* are in the American Museum of Natural History and the American Entomological Society.

Amphibolips racemaria (*Ashmead*).

Cynips q. racemaria Ashmead, Trans. Am. Ent. Soc., Vol. IX, 1881, p. xxvi. *Amphibolips racemaria* Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, pp.

294, 303; *ibid.*, Vol. XIV, 1887, p. 127; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Female. Head black, rather small, and deeply rugoso-punctate, face very slightly pubescent and a long tuft of pubescence back of the eyes. Antennæ 14-jointed, black. Thorax deeply coarsely and irregularly punctate. Pleuræ less deeply and coarsely punctate. Abdomen large, black and shining, apical half of second segment, and following segment excepting at the base, finely and densely punctate; second segment with a few hairs; ventral sheath very long. Legs reddish brown, coxæ black, pubescent. Wings smoky or brownish black, apices paler, veins black; radial area rather narrow. Areolet present. Length 4 to 4.25 mm.

Gall. (Plate XIV, Figs. 6, 7.) On the under side of leaf of laurel oak (*Quercus laurifolia*) in April and May. Globular or spherical, crisp, sour and succulent. Green when fresh, and brown and shriveled when dry. Internally with a reddish larval cell. Diameter 8 to 10 mm.

Habitat: Florida.

The gall very much resembles that of *Amphibolips nubili pennis.* The types are in the United States National Museum and one cotype gall is in the American Museum of Natural History.

Amphibolips prunus (*Walsh*).

Cynips quercus juglans Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1862, p. 255; Glover, Ill. N. Am. Ent., 1878, pl. viii, fig. 6 (gall only); Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 71.

Cynips juglans Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296.

Cynips quercus prunus Walsh, Proc. Ent. Soc. Phila., Vol. III, 1864, p. 639; Am. Ent. Vol. I, 1869, p. 104, fig. 80.

Amphibolips prunus Mayr, Gen. Gallenb. Cynip., 1881, p. 27; Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 130; Bull. 1, Col. Biol. Assoc., 1890, p. 38; Lintner, 4th Rep. Inj. Ins. N. Y., 1888, p. 24, figs. 18, 19; Gillette, Psyche, Vol. V, 1889, p. 184; Packard, 5th Rep. U. S. Ent. Com., 1890, p. 115; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 252; Am. Mus. Journ., Vol. IV, 1904, p. 98, fig. 18; Ins. Galls Vicin. N. Y., 1904, p. 12, fig. 18; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67; Cook, Proc. Indiana Acad. Sci., 1904, p. 225; 29th Rep. Dept. Geol. and Nat. Hist. Ind., 1904 (1905), p. 824, fig. 18; Felt, Ins. Affect. Park and Wood. Trees, Vol. II, 1906, p. 628.

Female. Head and thorax deep black, evenly and rather finely rugose. Antennæ 12-jointed, black, short, rather stout. Parapsidal grooves not visible; median groove present, but not distinct. Anterior parallel lines fine, and slightly diverging posteriorly. Lines near base of wings, rather long. Pleuræ finely rugose. Scutellum rugose, foveæ at base large, broad and scarcely separated by a ridge. Abdomen blackish, subopaque, finely and densely punctate; base shining, and not punctate, pubescent. Legs yellowish brown. Wings dusky with a brown shade from the base of the radial area to the apex. Length about 6 mm.

Gall. (Plate XV, Figs. 1, 2, 3.) On acorn cups of red oak (*Quercus rubra*), Scrub oak (*Quercus nana*), quercitron oak (*Quercus velutina*) and scarlet oak (*Quer-*

cus coccinea) in August and September. Bright red, more or less globular, smooth, and sometimes looking almost like a marble. When fresh it is solid but fleshy and of a pink color inside, shading into yellow toward the middle, where there is a single large larval chamber. Subsequently it becomes mature and it turns blood red, and when old and dry it becomes so hard as to be cut with difficulty. Diameter 15 to 25 mm.

Habitat: New England and Middle States; south to Georgia; and west to Colorado.

Amphibolips gainesi *Bassett.*

Amphibolips gainesi Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 322; Dalla Torre and Kieffer, Gen. Ins. Hymen. Cynip., 1902, p. 67.

Female. Head black, coarsely rugose with sparse, short, pale hairs. Antennæ rather short, 14-jointed. Mesothorax coarsely rugose, stout, parapsidal grooves very indistinct and scarcely discernible in the coarse rugosity of the surface. Anterior pair of parallel lines short, narrow and quite indistinct. Line of the base of wing rather broad and deep, but not pronounced. Pleuræ rugose, black. Scutellum rather large and rugose, truncately rounded posteriorly. Foveæ large, somewhat shining. Abdomen black, subopaque, very finely and densely punctate, basal half rather densely hairy, posterior margins of all the segments very narrowly smooth and shining. Legs reddish brown, hairy, tarsi dark brown. Wings dark smoky brown with a darker cloud from the first cross-vein to the apex. Veins dark brown, cross-veins very stout and shining. Areolet very large. Radial area open. Length 6 to 7 mm.

Gall. (Plate XV, Figs. 4, 5.) Attached by a small point to the sides of an acorn cup of black jack oak (*Quercus marylandica*). Perfectly round and smooth and of a dense corky substance. Internally it is rusty brown, contains a large central larval chamber, which is firmly imbedded in, and adherent to the surrounding mass. Diameter 24 to 42 mm.

Habitat: Texas (Austin).

The fly is one of the largest species and is closely allied to *Amphibolips prunus* Walsh. The gall is considerably larger than that of *A. prunus* and it does not shrivel up like *prunus*.

The types of the fly and gall are with the American Entomological Society, and type specimens of galls are also in the American Museum of Natural History. A fine series of galls of *A. gainesi* were kindly sent to me by Mr. C. Hartman, collected at Austin, Texas, the type locality for this species. I succeeded in rearing four females from these galls.

Amphibolips fuliginosa (*Ashmead*).

Cynips q. fuliginosa Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. vii.

Amphibolips fuliginosa Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294; *ibid.*, Vol. XIV, 1887, p. 130; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 104; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Holcaspis fuliginosa Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 303.

Female. Head black, rugose, and slightly pubescent. Antennæ black, 13-

jointed. Thorax almost evenly and uniformly rugose with the parapsidal grooves slightly traceable posteriorly. Anterior parallel lines rather long, and distinct. Pleuræ like the thorax. Scutellum more coarsely rugose with two large foveæ, tip rounded. Abdomen blackish, subopaque and rather finely and densely punctate, shining and smooth basally. Legs reddish brown, femora rather stout. Wings wholly smoky brown, veins darker. Length 4 to 5 mm.

Gall. (Plate XV, Figs. 6, 7.) On the twigs or possibly on the acorns of willow oak (*Quercus laurifoliæ*), in August. Rounded or spherical, smooth, and of a corky texture, with a central larval cell. Reddish brown and rather hard when dry. Diameter 8 to 12 mm.

Habitat: Georgia; Florida.

The adult is allied to *Amphibolips prunus* and *Amphibolips gainesi*, but differs in having the wings entirely smoky brown and by being considerably smaller. The gall has the appearance of a miniature gall of *Amphibolips prunus*, and is similar in structure. W. H. Ashmead states that the galls drop from large trees in August and that he was unable to find out whether they grow on the twigs or leaves. I am of the opinion that it is an acorn gall owing to the resemblance of the adult and structure of the gall to that of *A. prunus.*

The types are in the United States National Museum and cotype galls in the American Museum of Natural History.

Amphibolips palmeri *Bassett.*

Amphibolips palmeri Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 322; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 105; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Female. Head black, face unevenly wrinkled, vertex deeply and irregularly wrinkled. Antennæ black, very short, 13-jointed, first joint heavy, second joint short, third joint one-half longer than the first and second together, fourth joint one half as long as the third, remaining joints short, last joint a little longer than the twelfth. Mesothorax deeply and irregularly wrinkled with two obscure parallel lines and a line at the base of each wing. Parapsidal grooves faint and scarcely interrupt the rugosity of the surface. Scutellum very coarsely wrinkled and is much broader in the middle than on the anterior side, truncate and emarginate posteriorly; foveæ large, rugose with a low irregular line separating them and a high ridge bounding them at the sides, the whole polished and shining. Abdomen black, second segment covering one-half of the whole, anterior half smooth and shining and with a few scattered hairs. The posterior half and the visible parts of the other segments distinctly reticulated or punctate, except a narrow polished band on the margin of each. Legs black, shining with a few scattered hairs. Wings dark, smoky brown, with a very dark brown cloud covering the areolet and the lower half of the radial area; beyond this and extending across the radial area to almost the posterior margin is a light colorless spot and the anterior margin from the dark, broad, first cross-vein to a short distance beyond the second cross-vein is of the same light color; tip of wing beyond the pale spot, dark smoky brown as below this spot. Areolet very small, but well defined. Radial area open, large and broad. Length 6.5 mm.

Gall. (Plate XV, Figs. 10, 11.) On the terminal small twigs of a species of oak (*Quercus* sp.). Monothalames, round, with the surface uneven, or somewhat wrinkly, sometimes with a few scattered very short projections. Light yellowish brown; the outer shell is thin, but firm. Internally it is of a soft, uniform porous or spongy consistence, filling the entire gall. The larval cell is rounded and is embedded in the soft internal substance. Diameter 35 to 70 mm.

Habitat: Summit of Sierra Madre, Chihuahua, and Guadalajara, Jalisco, Mexico.

The largest known species of gall-fly and "oak apple gall." The types are in the collection of the American Entomological Society, and a specimen of the gall from Guadalajara, Mexico, is in the American Museum of Natural History.

Amphibolips trizonata *Ashmead.*

Amphibolips trizonata Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 125; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Male and female. Entirely black, antennæ, face, tibiæ, and tarsi dark brown; ocelli red; antennæ of the female 13-jointed, of the male 15-jointed. Head and thorax very coarsely rugose. Eyes large. Parapsidal grooves entirely wanting, anterior parallel lines and grooves on the shoulders present. Scutellum very coarsely rugose, with the foveæ large and almost confluent, separated only by a slight carina. Abdomen globose, polished, the apical portion of the second segment and the following segments minutely punctate. Wings hyaline with three smoky brown transverse bands, the one at the base not as distinct as the one across the middle and the one at the apex of the wing; veins pitchy brown. Areolet wanting. Length 5 to 6 mm.

Gall. (Plate XV, Figs. 8, 9.) On the young twigs of a species of oak in June. Almost or entirely globular with a moderately thick outer shell. Yellowish and almost smooth. Internally it is completely filled with a soft, pithy substance like *Amphibolips palmeri*. Centrally there is a larval cell which is fastened to the surrounding mass. Diameter 20 to 35 mm.

Habitat: Arizona (Fort Grant).

The types of the flies and galls of this distinct species are in the United States National Museum and cotype galls in the American Museum of Natural History. The characteristic band on the wings readily distinguishes it from all other known *Amphibolips*. The gall very much resembles that of *Andricus spongiola* Gillette, but the internal substance of *trizonata* is much softer and separable from the outer shell. According to W. H. Ashmead, the gall is said to grow on the blossoms of an oak.

Amphibolips badia *Bassett.*

Amphibolips badius Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 323.

Amphibolips badia Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 67.

Female. "Head, antennæ, thorax and legs dark brownish red. Head and thorax covered with short, appressed hairs. Antennæ short, only half as long as the body, thirteen jointed, first joint short, second very short and globular, third one third longer than the two preceding taken together, fourth one third shorter than the third, fifth and sixth gradually shorter; joints 3, 4, 5, and 6 larger at the apex than at the base. Face covered with appressed hairs, and there is an obscure, converging line from the base of each antennæ to the mouth. Head rather small, not broader than the thorax. Prothorax anteriorly a very narrow shining band. Mesothorax full and rounded in front, finely and evenly but rather sparsely punctate. Parapsidal grooves and other lines very indistinct, mainly because of the short, dense and closely appressed hairs. These obscure completely the parapsidal grooves posteriorly. Scutellum small, rounded and slightly elevated posteriorly, and the hairiness coarser and more dense than on the mesothorax. Foveæ small, almost obsolete. Legs darker than the thorax, densely covered with short, fine and closely appressed hairs. Abdomen large, black and shining, second segment dorsally very long, nearly concealing the other segments, but retreating ventrally to less than one-half the dorsal length. The sides of this segment are covered with a dense patch of shining reddish hairs. Wings shining, dark smoky brown, veins dark, almost black. Areolet small. Cubitus disappearing a short distance from the first cross-vein. Length 6 mm. H. F. Bassett."

Gall. Unknown.

Habitat: Connecticut (Waterbury).

This species was described from a single female captured at large by H. F. Bassett, on a terminal bud of a shoot of a thrifty clump of white oak sprouts. The type is in the American Entomological Society.

Amphibolips verna *Bassett.*

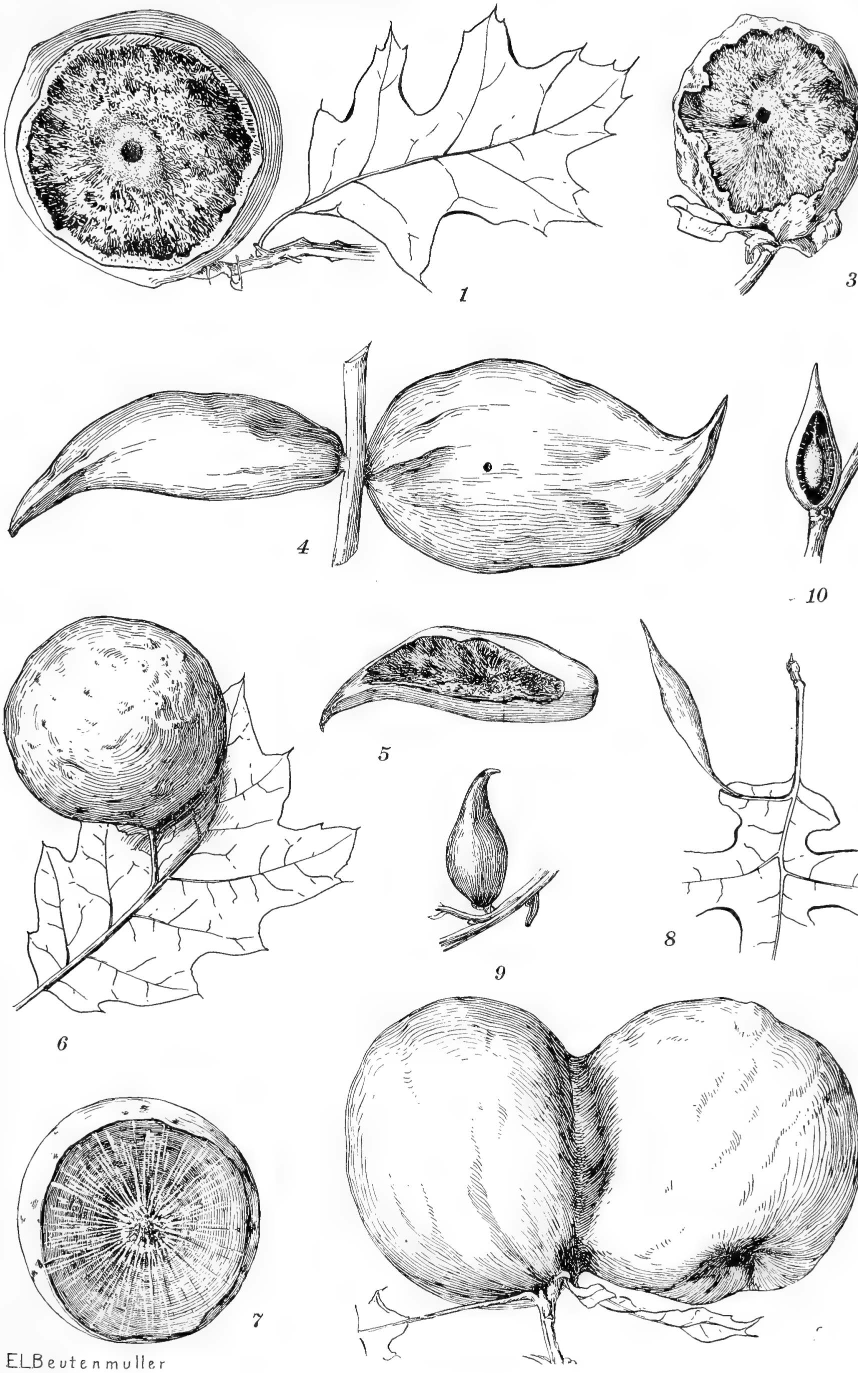
Amphibolips verna Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 321; Dalle Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Female. Head small, rugose, black. Antennæ black, 14-jointed, first joint long, stout, second one-half as long as the first, third a little longer than the first and second together and slightly curved, fourth two-thirds, and the fifth one-half as long as the third, sixth to thirteenth equal, fourteenth one half longer than the thirteenth. Thorax small, rugose and thinly covered with short hairs. Anterior parallel lines extending more than half way to the scutellum. Parapsidal grooves very obscure and the lines over the base of the wings rather less so, all short. Scutellum small, rugose. Foveæ large, shallow and not smooth. Abdomen large dusky black, shining, and minutely punctate, hairy basally, as is also the posterior margin of the last segment and the sheath of the ovipositor. Legs uniform dark red. Wings pale fuscous, veins reddish brown, not heavy. Areolet large and nearer the anterior margin than in most species. Cubitus slender, reaching the first cross-vein. Length 4.50 mm.

Habitat: Connecticut (Waterbury).

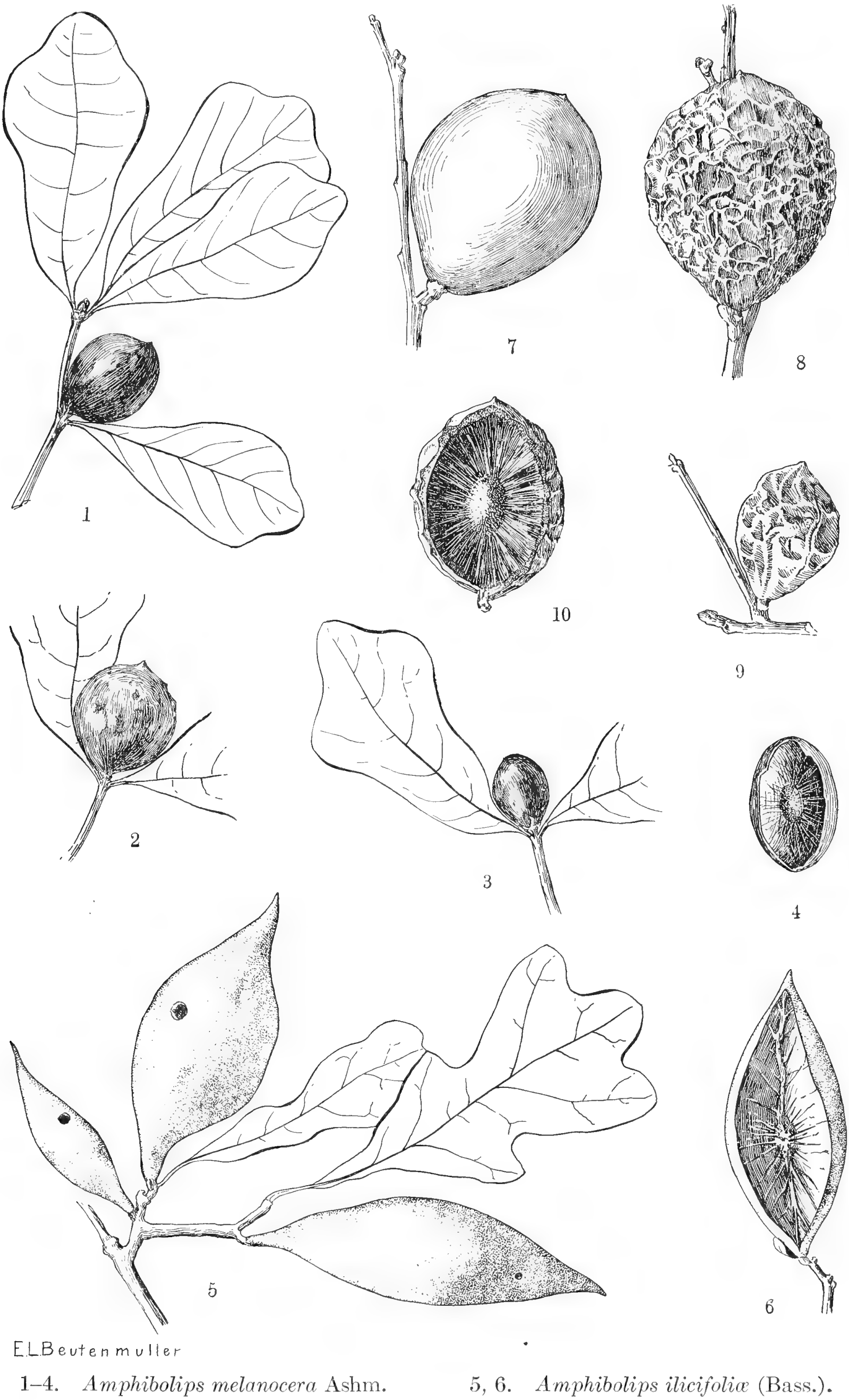
Only known by a single female taken by H. F. Bassett, ovipositing in the buds of scrub oak (*Quercus nana*) on April 9, 1897. The type is with the American Entomological Society.

Amphibolips confluens (Harris).

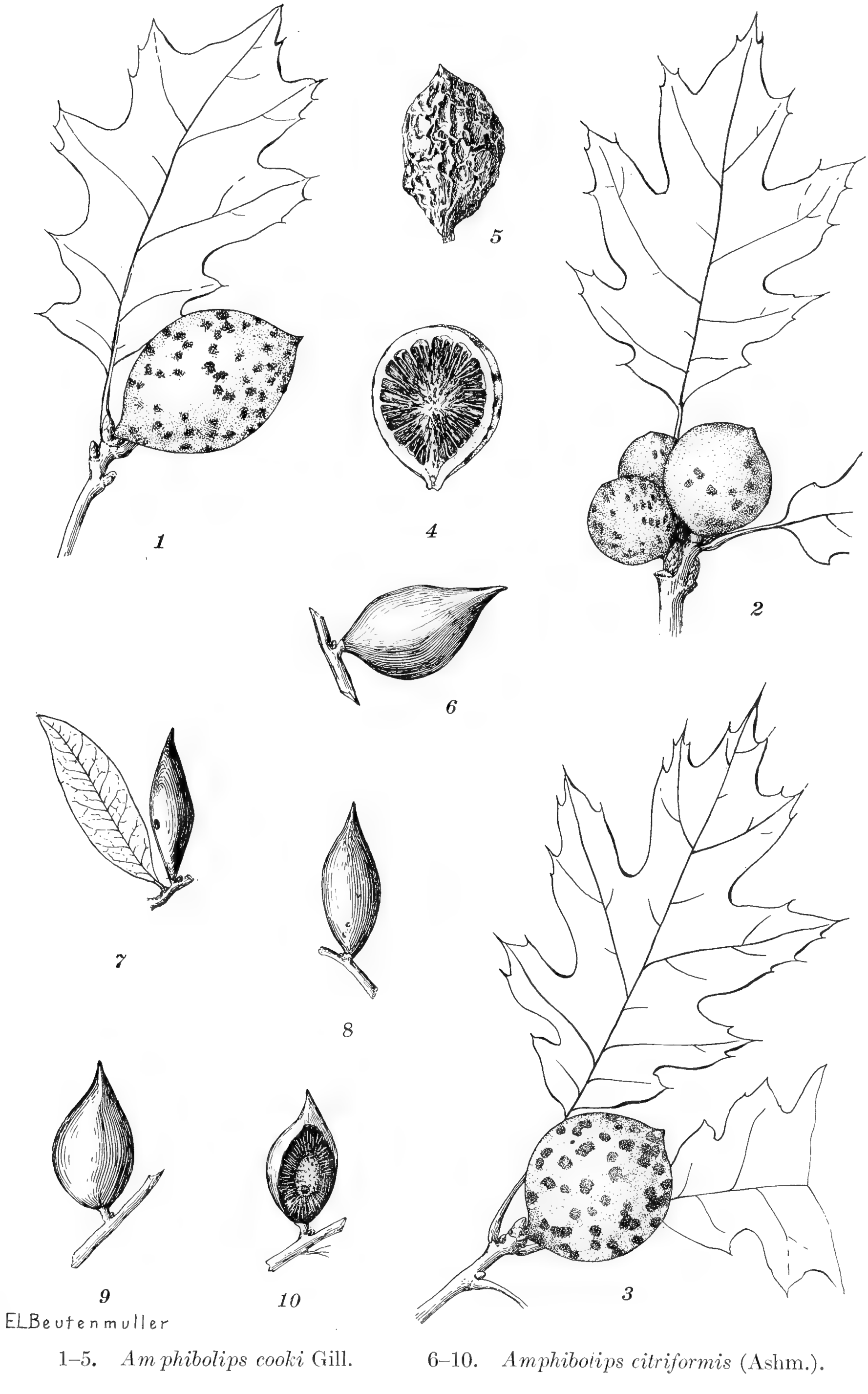


E.L.Beutenmuller

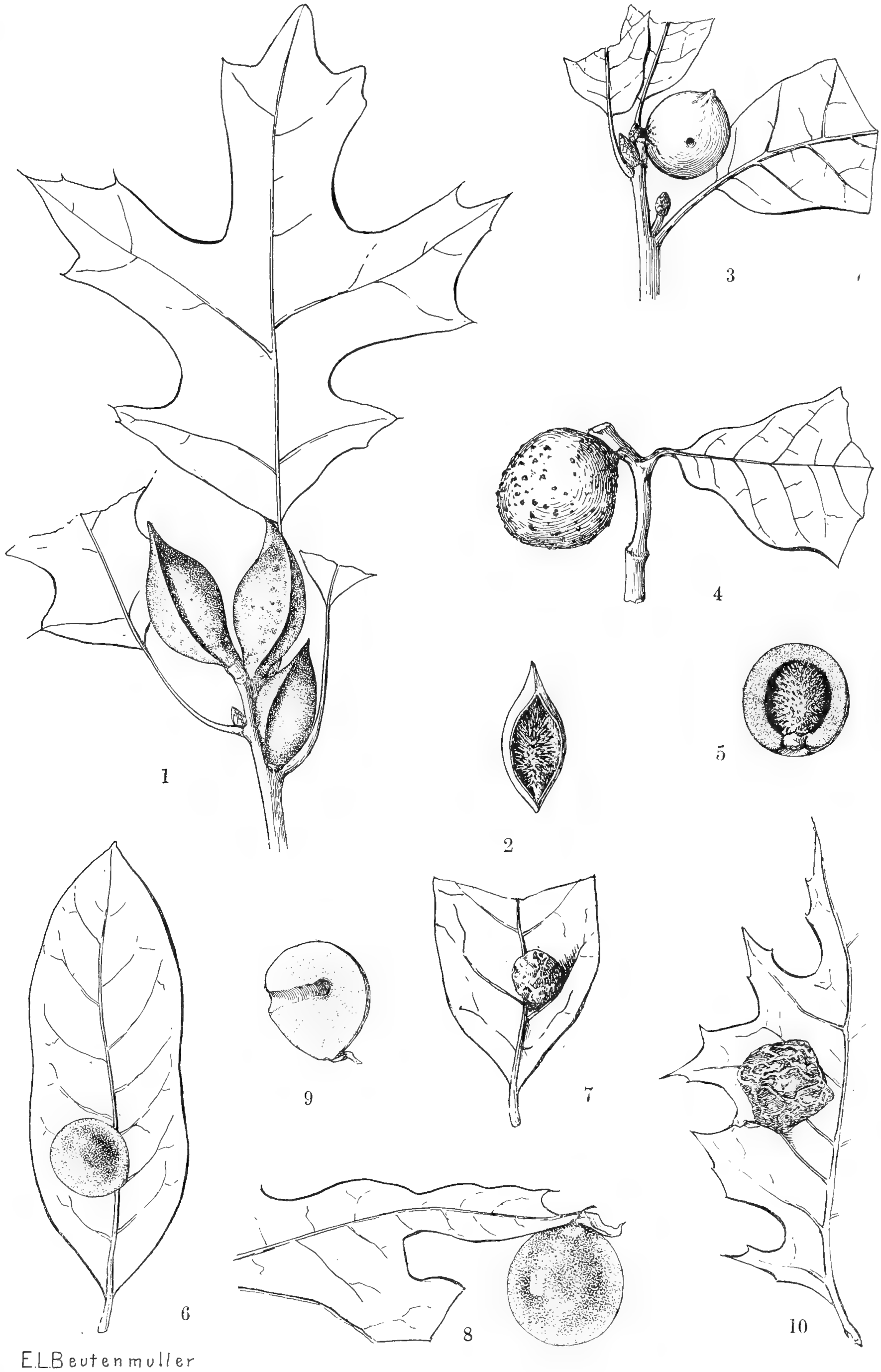
1, 2. *Amphibolips confluens* (Harris). 4, 5. *Amphibolips acuminata* Ashm.
3. " *carolinensis* Bassett. 6, 7. " *inanis* (O. S.).
8–10. *Amphibolips coelebs* (O. S.).



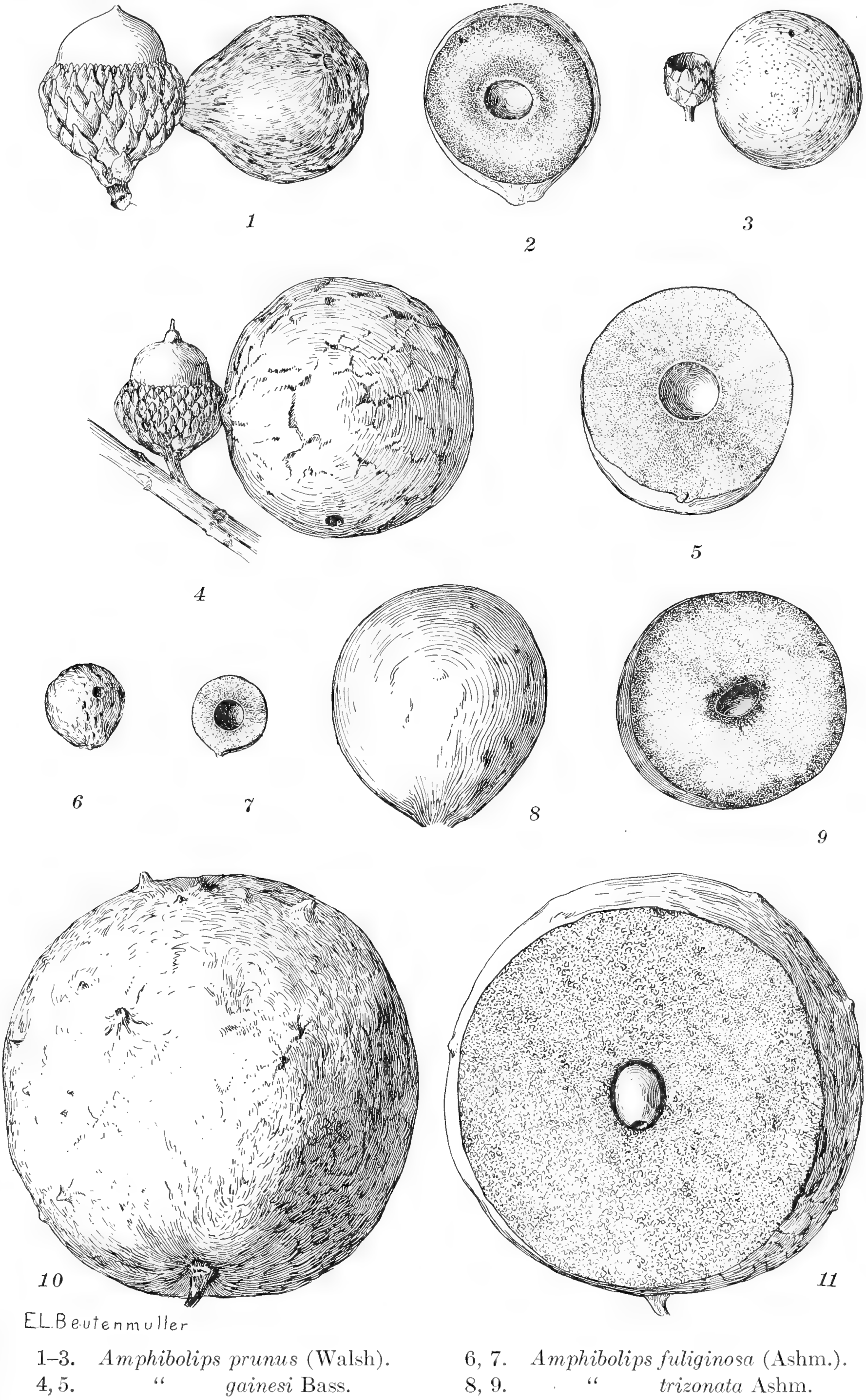
1–4. *Amphibolips melanocera* Ashm. 5, 6. *Amphibolips ilicifoliæ* (Bass.).
7–10. *Amphibolips cinerea* Ashm.



1–5. *Amphibolips cooki* Gill. 6–10. *Amphibolips citriformis* (Ashm.).



1, 2. *Amphibolips tinctoriæ* Ashm.
3–5. " *globulus* sp. nov.
6, 7. *Amphibolips racemaria* (Ashm.).
8–10. " *nubilipennis* (Harr.).



1–3. *Amphibolips prunus* (Walsh). 6, 7. *Amphibolips fuliginosa* (Ashm.).
4, 5. " *gainesi* Bass. 8, 9. " *trizonata* Ashm.
10, 11. *Amphibolips palmeri* Bass.

56.57,7(78.8)

Article VII.— FOSSIL INSECTS FROM FLORISSANT, COLORADO.

By T. D. A. Cockerell.

Plate XVI.

DIPTERA.

Tabanidæ.

Tabanus parahippi sp. nov.

Plate XVI, Figs. 1, 1*a*.

♂. Length $18\frac{1}{2}$ mm.; wings 12; width of head 4; width of thorax 5; length of thorax $5\frac{3}{4}$; length of abdomen $10\frac{2}{3}$; width of second segment about $5\frac{1}{2}$; of fourth a little over 4 mm. Head and thorax black or almost; abdomen conical, as preserved dull ferruginous, without markings, but with the sutures broadly hyaline (the chitinous rings being partly separated, making the abdomen longer than in life). Legs dark brown or black. Abdomen with fine hair (no bristles). Wings brownish hyaline, not at all spotted; nervures pale reddish, obscure. Venation quite normal for *Tabanus*.

Eyes holoptic, wholly without hair, the upper facets about twice as large as the outer (lower) ones. The antennæ have short fuscous hair on the basal part; the apical part is not visible.

The venation, compared with Williston's figure of *Tabanus* (N. A. Dipt. p. 179), differs thus:

(1.) The second vein has its apical portion quite strongly sinuous, with a double curve. (I find this character in *Chrysops lupus* Whitn., a recent species collected at Florissant.)

(2.) The first basal cell is a little shorter, being somewhat shorter than the second.

(3.) The first branch of fourth vein is not arched as it leaves the discal cell. In Hine's table of *Tabanus* of Western U. S., this runs to *T. ægrotus*. In his table of *Tabanus* of Ohio it runs to *T. americanus*, except that the costal cells are not darkened.

Hab.— Miocene shales of Florissant, 1907. It is named after a genus of Miocene Equidæ occurring in Colorado, which it probably tormented.

Tabanus hipparionis sp. nov.

Plate XVI, Figs. 2, 2*a*.

Length about $16\frac{1}{3}$ mm.; wing about 12; width of abdomen at third segment $5\frac{3}{4}$ mm. Eyes not hairy; head and thorax black; abdomen dark reddish brown, wholly without bristles, as preserved with the rings separated and the sutures broadly hyaline; legs dark reddish brown; middle tibiæ with two apical spurs (a

character of all Tabanidæ), hind tibiæ without spurs; tarsi exactly normal for *Tabanus*, with the same claws, pulvillus, fine bristle-like hairs, deeply emarginate penultimate joint, etc.

Wings dusky, subhyaline; first vein strong and dark, the others pale ferruginous. The second vein is not sinuous, but is as in Williston's figure (N. A. Dipt., p. 179). Second and third posterior cells much shorter than in Williston's figure, the discal cell ending nearer the margin (the upper side of the second cell is about equal to the marginal or outer sides of second and third combined; *T. reinwardtii* Wied., found living at Boulder, Colorado, has these cells short, though not quite so short as in *T. hipparionis*). The fourth posterior cell is extremely narrow basally, and its side on discal cell is about twice as long as that on third posterior. The anal and basal cells are normal.

Hab.— Miocene shales of Florissant, collected 1907.

Therevidæ.

Psilocephala hypogæa sp. nov.

Plate XVI, Figs. 3, 3*a*.

♀. Length 10 mm.; wing about $6\frac{1}{2}$, hyaline; head, thorax and abdomen black, shining; width of abdomen $2\frac{3}{4}$ mm., its length about $5\frac{1}{2}$ mm. Abdominal segments 2 to 5 are practically equal in length, whereas in *P. platancala* Lw. they are successively shorter. Eyes widely separated on vertex; antennæ less than 1 mm. long, slender, not hairy; face not at all hairy; legs ferruginous, perhaps black basally.

Anterior cross-vein about middle of discal cell; fourth posterior cell widely open. Discal cell about 2 mm. long; second submarginal cell about 2 mm. long and half a mm. wide at apex.

Compared with *P. platancala* Lw. (Boulder, Colorado, June, 1905, *W. P. Cockerell*, det. Johnson) it differs as follows:—

(1.) The second submarginal cell is much narrower, and the discal cell is longer.

(2.) The second vein reaches the margin of the wing a little *beyond* the middle of second submarginal cell (much *before* middle in *P. platancala*). The subcosta or auxiliary vein is not shifted, hence it results that the terminations of the auxiliary and first veins are much wider apart.

(3.) The anterior cross-vein is somewhat more oblique; and the third vein is not at all deflected or bent to meet it, as it is in *P. platancala.*

It differs from *P. scudderi* Ckll. by the perfectly clear wings; and from both *scudderi* and *platancala* by the fourth posterior cell, which is almost as widely open as the second. This is not considered a generic character; Coquillett enumerates many living North American species having the fourth cell open.

Hab.— Miocene shales of Florissant, 1908.

A second specimen, found by Mr. Geo. N. Rohwer, presents the insect in lateral view (the type shows the dorsal aspect), and brings out the fact that the thorax in profile is very convex above; much more so than in *P. platancala.* It also shows that the claws are large, about 255 μ long, not allowing for the curve. I cannot distinctly see pulvilli or empodia; but

pulvilli are indicated, small and narrow. The wings are not quite so long as in the type, and the specimen is probably a male. The abdomen, except for the practically equal segments 2 to 5, agrees exactly in shape and appearance with *Psilocephala.*

Meunier's *Psilocephala agilis,* from Baltic amber, has the fourth posterior cell closed; it differs greatly (according to the figure) from the modern genus by the excessive length of the second and third veins. Perhaps it should form a distinct genus. The genus *Psilocephala* lives to-day at Florissant, where I took a specimen of *P. munda* Lw. (det. Coquillett).

Asilidæ.

Asilus peritulus sp. nov.

Wing about 13 mm. long, pale reddish, the nervures ferruginous. Other parts not preserved. In Williston's tables (N. A. Dipt.) it runs to *Asilus,* and compared with *Asilus* (*Tolmerus*) *notatus* Wied. (Vinton, Ohio, *Hine*) it is practically the same, except in the following particulars:

(1.) In *A. peritulus* the apex of marginal cell is more acute, the lower nervure scarcely at all bowed or curved subapically.

(2.) The second submarginal cell is longer (length $3\frac{3}{4}$ mm.), and very much longer than the part of R_{4+5} from the anterior cross-vein to the fork, the latter being 2 mm. long.

(3.) The second posterior cell bulges more at the sides.

(4.) The anterior cross-vein is conspicuously beyond the middle of the discal cell.

(5.) The fourth posterior cell is broader (higher); its apical width is 1 mm. or slightly more.

Hab.— Miocene shales of Florissant, Sta. 13 B, collected in 1907. *Fagus longifolia* occurs on the same piece of shale.

From *Proctacanthus* it is easily separated by the lower branch of third vein being below the tip of the wing; from *Erax* by the total absence of any spur on the basal part of the upper branch of the third vein.

Leptidæ.

Leptis mystaceæformis sp. nov.

Length 9 mm., expanse about 14; width of abdomen near base fully 2 mm. Abdomen with fine appressed dark brown hairs, not at all dense. Anal cell about 100 μ broad at apex, but actually closed, the bounding nervures being continuous around the apex. Antennæ not visible.

Head and mesothorax black, the latter apparently without any stripes; scutellum and sides of thorax ferruginous; legs light ferruginous, the tarsi fuscous; wings reddish hyaline, not spotted, but the marginal cell darkened; abdomen pale ferruginous, with darker ferruginous markings, viz. a triangle on second segment, triangles

with lateral expansions (forming bands) on third and fourth, a large quadrate mark, broader than long, but broadly excavated behind, on fifth, and smaller marks on sixth.

Very different from *L. florissantina* Ckll. by the tapering abdomen (which has dark markings almost exactly as in *L. mystacea* Macq.); the shorter marginal cell (which is strongly clouded, and wider in the middle than at the apex); the strongly elbowed base of upper branch of third vein (which is exactly as in *L. mystacea*); the first basal cell not longer, but a trifle shorter, than the second (also as in *L. mystacea*); and the broader (deeper) anal cell. The wings are much broader (deeper) than in *L. florissantina*, their breadth being about 3 mm.

Hab.— Miocene shales of Florissant, Sta. 13 B (*S. A. Rohwer*, 1908).

Bombyliidæ.

Melanderella gen. nov.

Rather small flies, with cylindrical abdomen, which extends a short distance beyond the wings. Mouth parts exserted, stout but long, about as long as the thorax, bifid at the end, the labella large and quite broad. Antennæ not hairy, about 680 μ long, the terminal joint occupying nearly half the length, fusiform in shape narrowed basally and apically, about 100 μ diameter in middle; the general structure of the antennæ being essentially as in *Lordotus* (cf. Williston's figure, N. A. Dipt.), except that they are less slender, and not hairy. The form of the last joint is not as in *Dolichomyia.*

The mouth-parts recall those of *Lepidophora.* The venation is nearly as in *Systropus,* but the form of the body is entirely different.

Wings hyaline, with three posterior and two submarginal cells; in Williston's tables (N. A. Dipt.) it runs to *Dolichomyia,* which it closely resembles in venation, differing as follows:—

(1.) The second vein leaves the third at the same point as the latter leaves first.

(2.) The lower median angle or corner of discal cell is nearly on a level with (*i. e.* below) the anterior cross-vein.

(3.) The basal side of the third posterior cell is straight (strongly bowed in *Dolichomyia*).

(4.) The anal cell is large and complete, being just closed on the wing margin.

The upper side of the second submarginal cell has an even double curve, with no angle or projecting vein. The first posterior cell is very widely open. If it had four posterior cells it would run in Williston's tables to *Acreotrichus* or *Phthiria.* It is not at all like *Phthiria.*

The genus is dedicated to Prof. A. L. Melander, in recognition of his work on Diptera and on fossil insects.

Melanderella glossalis sp. nov.

Length about 7 mm.; abdomen not quite $4\frac{1}{2}$; wing 5; proboscis 2; hind femora 3; hind tibia $2\frac{3}{5}$; hind tarsi about $2\frac{3}{4}$ mm. Head broad; head and thorax black; abdomen dark reddish-brown, as preserved with the sutures colorless; legs reddish-

brown, the hind femora rather stout, their tibiæ and tarsi slender; wings hyaline, nervures reddish-brown, area between first vein and costa darkened; antennæ black or almost.

Anterior cross-vein 850 μ from base of discal cell, and 561 from its apex.

Breadth of labella (each) about 170 μ; breadth of proboscis near middle about 340 μ.

Hab.— Miocene shales of Florissant, Sta. 13 B. (*Melford Smith,* 1908.) On the same slab, close to the fly, is a leaf of *Fagus longifolia.*

Lithocosmus gen. nov.

Runs in Williston's table (N. A. Dipt.) to 26, where the next dichotomy depends on the anal cell. The anal cell appears to be very narrowly open, having a width at apex of about 70 μ, but the nervures actually circle around the margin, closing it. If the anal cell is regarded as closed, it runs to *Oncodocera,* which it does not resemble at all. If the cell is regarded as open, it appears to run to *Metacosmus,* but I cannot see an ocellar tubercle. The antennæ will not do for *Lepidophora.* There is no sign of any elongate proboscis.

Lithocosmus agrees with *Metacosmus* in its elongated form and naked body, and in the tip of the second vein meeting the costa at an acute angle. *Metacosmus* has the second submarginal cell nearly straight along its upper edge; this is not at all the case in *Lithocosmus. Metacosmus* has the small or anterior cross-vein beyond the middle of discal cell; it is a little before the middle in *Lithocosmus.*

Lithocosmus has two submarginal and four posterior cells, the first posterior narrowed apically; the usual spurious vein below the fifth is present. The antennæ are peculiar, the last joint being broad-oval about 200 μ long, with a short but conspicuous terminal spiniform process, about 35 μ long. The other joints are short and broad. This type of antenna seems to be between those of *Spogostylum* and *Pachysystropus.*

Lithocosmus coquilletti sp. nov.

Plate XVI, Figs. 4, 4*a*.

Length about 9 mm., wing a little over 7 mm.; head and thorax black, head rather large; abdomen dark reddish-brown, with (as preserved) the sutures colorless; wings dusky, but not very dark; abdomen long and parallel-sided, the width near base about 2 mm.; whole insect apparently hairless, but with a microscope it can be seen that the hind margins of the abdominal segments are sparsely beset with black bristles, about 250 μ long, directed backwards; tarsi pale ferruginous, with very fine ferruginous hair; tibiæ apparently also ferruginous, but femora dark.

First posterior cell about 187 μ wide at apex, and 374 in middle; base of second submarginal cell obliquely truncate, the bend in the bounding nervure being abrupt; second vein leaving third about 500 μ from origin of latter, but as the third runs very close to the first, this is not apparent without a microscope; a fine extra or spurious vein leaves the second very near its origin, and runs parallel with and very close to

the third for more than 1700 μ; second vein entering costa at an angle little smaller than a right angle, and 425 μ from end of upper branch of third, the latter, at its apex, being practically parallel with the second (this arrangement is practically as in *Systoechus,* though in *Systoechus* the upper branch of third is not abruptly bent); subcosta entering costa at a very acute angle. The basal cells are nearly as in *Lordotus,* but the second is considerably longer in proportion to its breadth.

By a curious aberration on the left side there are two small or anterior cross-veins, bounding a little cell about 220 μ broad and 170 deep. The first of these cross-veins is 1020 μ from the base of discal cell, the second 1070 from the apex of that cell. On the other side, the anterior cross-vein is single and normal (a little oblique) and 1020 μ from base of discal cell.

Hab.— Miocene shales of Florissant 1908.

Named after Mr. Coquillett whose writings on Bombyliidæ have been of great service in this investigation.

Syrphidæ.

Chilosia miocenica sp. nov.

Plate XVI, Figs. 5, 5*a*.

Length about 9½ mm.; width of thorax 4; abdomen oval, its width 3½ mm., the widest point being at the junction of second and third segments; length of wing 9 mm., wings faintly dusky, with dark veins, stigmatal area slightly yellowish; head and thorax black, shining; legs apparently dark reddish, and rather short and stout; abdomen very dark reddish, with broad but suffused light basal or subbasal bands on segments 2 and 3, that on 2 interrupted in the middle by a narrow but very distinct longitudinal dark band, that on 3 with the middle third suffusedly darkened, thus it cannot be said that the abdomen has any *entire* light bands; first abdominal segment with long dark hairs, lacking on the following segments.

The form of the insect is that of *Chilosia;* the marking of the abdomen is suggestive of *Melanostoma.*

The venation almost agrees with Williston's figure of *Chilosia* (N. A. Dipt., p. 250, f. 8), but differs as follows:—

(1.) The cross-vein between costa and subcosta is vertical, *i. e.* at right angles to costa.

(2.) The subcosta or auxiliary vein enters the costa at a very acute angle, its terminal part not being abruptly bent (*i. e.* it is as in *Didea*).

(3.) The apical part of the second longitudinal vein has a more distinct double curve.

(4.) The third longitudinal is quite strongly curved, and ends on the margin (the apical section being in a line with that before) *below* the tip of the wing (nearly as in *Rhingia nasica*).

(5.) The lower apical corner of the first posterior cell is less prominent.

Hab.— Miocene shales of Florissant, 1908. Another specimen, collected at Station 14 (*S. A. Rohwer,* 1907), differs from the type by the shorter wings, not quite 8 mm. long. It has the abdomen dark-banded along the sutures.

Scudder has described a *Chilosia* from the Green River beds, Wyoming. Williston (Synops. N. A. Syrphidæ, p. 282) has referred to the occurrence of species of *Chilosia* in the Florissant shales, without naming or describing them.

Mr. H. E. Burke has shown that the larvæ of *Chilosia* injure the timber of various coniferous trees; evidence of their work may be expected to be found in the fossil wood (*Sequoia*) of Florissant.

NEUROPTERA.

Raphidiidæ.

Raphidia exhumata sp. nov.

Represented by an anterior wing, with the usual large costal area.

Wing 12¼ mm. long, 4 broad; hyaline, nervures piceous; stigma rather dark ferruginous, with an oblique cross-vein. Length of stigma about 2 mm.

Cross-nervures of costal area, counting from the one above the branching of R and M apicad, are seven, unevenly spaced, the fourth and fifth approaching below. Subcosta reaching costa at a distance from pterostigma less than the length of the lower side of the latter. R_1 (as in *Megaraphidia*) with two branches beyond pterostigma (one in *Raphidia oblita* and *R. rhodopica*). Cross-vein from R_1 to R_2 before stigma normal but second cross-vein arising from near beginning of apical fourth of stigma, practically as in *Megaraphidia* (beyond stigma in *R. oblita* and *rhodopica*); it enters R_2 (which is bent at this point, as in *R. rhodopica*) some distance before the next branch of the latter (also as in *R. rhodopica*). Lower side of stigma long, as in *R. oblita*, and very different from *R. rhodopica.* R_2 with three branches in its terminal part, the two uppermost forking (three branches in *R. rhodopica*, the uppermost one forking; five branches in *Megaraphidia*). R_3 arising practically as in *Megaraphidia, but not forked*; from its point of origin arises a cross-vein to R_{4+5}. R_{4+5} with a single long fork as in *R. oblita* (in *R. rhodopica* the branches are forked at end.) Three cross-veins from Rs to M; (1.) near origin of Rs, (2.) at first forking of Rs. (3.) about half way between cross-vein to R_3 and separation of R_{4+5}, (this is different from *Megaraphidia* or *R. oblita* or *R. rhodopica*). The three cells below media as in *R. oblita* and *R. rhodopica*, except that the second is longer, and the third longer than the second; this is nearer to *R. oblita* than to *rhodopica.* Six forks on lower margin of wing, not counting that of R_{4+5}; these are all large except the fourth, which is small; the fifth is larger than the sixth, (four forks in *R. oblita*, fewer in *R. rhodopica*). Cells below Cu_1 practically as in *R. rhodopica*, but sides of first cell parallel; no long cell next to (beyond) the second, such as there is in *Megaraphidia* and *R. oblita.* Cells below Cu_2 as in *Raphidia.* Cells below anal as in *R. oblita*, except that the last cross-nervure to margin is lacking.

Hab.— Miocene shales of Florissant, Sta. 13 B (*S. A. Rohwer*, 1908).

This does not agree with any of Scudder's Florissant species; it is larger than his largest, which has the wing 10½ mm. long and 2.7 broad.

TRICHOPTERA.

In Bull. Amer. Mus. N. H., XXIII, p. 611, I proposed to regard *Derobrochus abstractus* as the type of *Derobrochus* Scudder. However, *D. frigescens* Scudd. was figured in Zittel's Handbuch several years before the other species were published, and although no description was offered, I think th's entitles it to be regarded as the type of the genus.

HETEROPTERA.

Pentatomidæ.

Teleoschistus rigoratus Scudder.

Station 14 (*S. A. Rohwer*, 1907.) The specimen shows the antennæ, which were wanting in Scudder's examples. They are 7 mm. long, or very nearly; the last four joints have the apical half, more or less, darkened, the basal part pale. In form they resemble those of *Euschistus*.

I designate as the type of *Teleoschistus* Scudder the first species, *T. antiquus* (Scudd.).

HOMOPTERA.

Aphididæ.

Anconatus gillettei Ckll.

This was briefly noticed in Nature, Aug. 6, 1908, p. 319.

Head and thorax dark reddish brown, abdomen very pale ochreous; femora reddish-brown, tibiæ black; stigma reddish-brown; third discoidal vein colorless or almost before the fork. Length of body $5\frac{3}{5}$ mm., of wing about 9 mm.; anterior femora about $2\frac{1}{2}$ mm.; anterior tibiæ over 3 (apex lost); middle tibiæ about $3\frac{1}{2}$ mm.

The following wing-measurements are in μ:—

Origin of first discoidal vein to origin of second discoidal about 561.

Origin of second discoidal to origin of third discoidal (base of third invisible, however), about 850.

Forking of third discoidal before level of origin of stigmatic, about 714

Depth of marginal cell at end of stigma	595
Stigma on maginal cell	1580
Depth of stigma	425

Width of cell between forks of third discoidal vein 850.

Hab.— Miocene shales of Florissant, Sta. 13 B (1908).

Aphidopsis lutaria Scudder.

Station 13 (*S. A. Rohwer*). Head and thorax dark brown; abdomen very light, with a series of large mid-dorsal dark transverse patches or spots, which have about one-third the diameter of the abdomen. Femora brown; tibiæ and tarsi black. Antennæ 6 mm. long or almost. Apical margin of wings broadly suffused with dusky.

Anterior wings 5 mm. long, or a fraction over; hind femora 2380 μ long, anterior femora 1700 μ. The marginal cell is like that of *Pemphigus*, which is otherwise different. There is a certain resemblance to *Lachnus* in venation, but the long antennæ are totally different.

The following wing measurements are in μ:—

Origin of first discoidal or transverse vein to origin of second	238.
Origin of second discoidal to origin of third	561
Origin of third to origin of stigmatic or stigmal vein (which is at middle of stigma)	1326
Length of marginal cell	2040
Origin of third discoidal vein to first fork	765
Origin of first fork to origin of second	1326
Length of lower branch of first fork	1904
Length of upper branch of second fork	1360
Length of lower branch of second fork	1054

FULGORIDÆ (CIXIINÆ).

Florissantia elegans Scudder.

A good specimen was found by Mr. S. A. Rohwer at Station 13 B. It shows more of the venation than Scudder's type, and so permits a more precise diagnosis. Venation in most respects agreeing with that of *Oliarus*. Compared with that of *O. tamehameha* Kirkaldy (Faun Hawaiiensis, Hemiptera, Pl. IV, f. 4) it differs as follows: Costa not so full basally; Subcosta branching from radius earlier (6 mm. from tip and 5½ from base of tegmen); apical part of radius with three branches to costa; radial cell extremely long (about 5¾ mm.) and reaching to within 1½ mm. of base of tegmen; median cell similar to radial, scarcely surpassing it basally, and falling less than half a mm. short of it apically; lower apical corner of radial cell emitting two long veins to the outer margin, distinct from the base, the upper long-forked, the lower simple. The cell in the forks of the cubitus is like that of the *Oliarus*. There is a very distinct dark stigma. The abdomen appears to be entirely as in *Oliarus*.

The numerous living species of *Oliarus* differ in the details of their venation, and it may be that some nearly agree with *Florissantia*.

ORTHOPTERA.

Blattidæ.

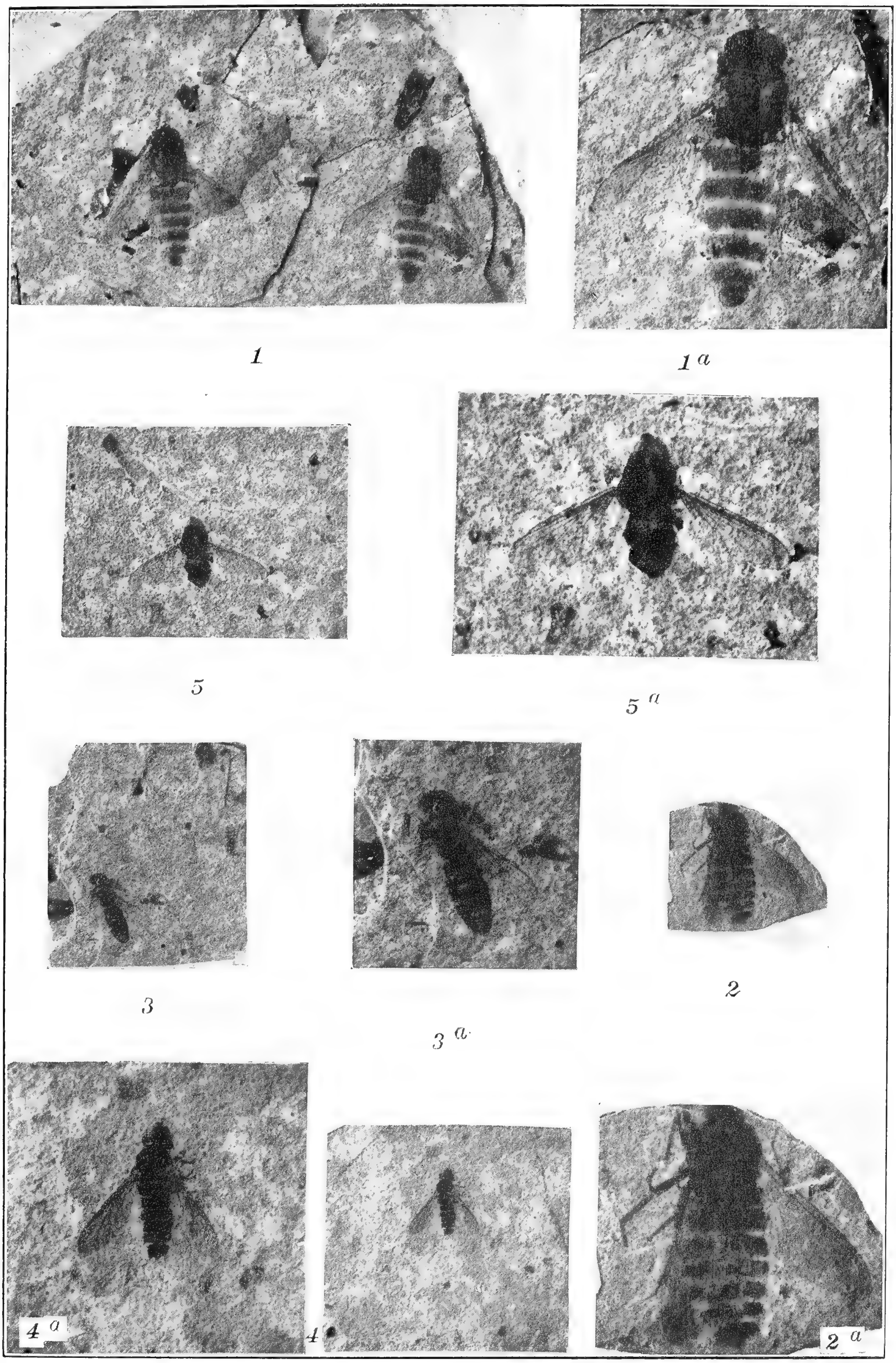
Ischnoptera brunneri (sp. nov.?).

This seems to be Scudder's *Zetobora brunneri*; a better specimen than his type. I only doubt the identity because the insect seems to me to be a typical *Ischnoptera*, and the measurements do not wholly agree. Provisionally, I treat it as a distinct species, but apply the specific name *brunneri*, so that if it proves identical with Scudder's no change will be necessary.

The middle and hind femora are spined beneath. The venation, so far as visible, agrees with *Ischnoptera*; so also the legs, and the broad rounded pronotum, which is dark in the middle, but very broadly light laterally, the extreme margin with a fine black line. The humeral areas of the tegmina are light, exactly as in *Ischnoptera*. The tegmina surpass the abdomen by about $5\frac{1}{2}$ mm.; antennæ with 16 mm. preserved, the apex wanting; cerci large, about $3\frac{1}{4}$ mm. long.

Body 20 mm. long (Scudder's *Zetobora* was 17); pronotum 6 mm. across (Scudder's the same), its length in middle about $3\frac{1}{3}$; length of hind femora $5\frac{2}{3}$; of tegmina about $21\frac{1}{2}$. Counting from the first (the one bounding the humeral space), twelve nervures reach the margin in 10 mm. length of that margin.

Hab.— Miocene shales of Florissant, Sta. 13 B (*T. D. A. Cockerell*, 1908).



FOSSIL INSECTS, FLORISSANT, COLORADO.

1 ($\frac{1}{1}$) and 1*a* ($\frac{2}{1}$). *Tabanus parahippi* sp. nov. 2 ($\frac{1}{1}$) and 2*a* ($\frac{2}{1}$). *Tabanus hipparionis* sp. nov.
3 ($\frac{1}{1}$) and 3*a* ($\frac{2}{1}$). *Psilocephala hypogæa* sp. nov. 4 ($\frac{1}{1}$) and 4*a* ($\frac{2}{1}$). *Lithocosmus coquilletti* sp. nov.
5 ($\frac{1}{1}$) and 5*a* ($\frac{2}{1}$). *Chilosia miocenica* sp. nov.

56.57(118:7)

Article VIII.— A CATALOGUE OF THE GENERIC NAMES BASED ON AMERICAN INSECTS AND ARACHNIDS FROM THE TERTIARY ROCKS, WITH INDICATIONS OF THE TYPE SPECIES.

By T. D. A. Cockerell.

The present list includes all the genera from the American Tertiaries supposed to be extinct, as no extinct European genera have been recognized in our rocks, with the exception of one or two which have been first named from American specimens. In Handlirsch's great work, "Die Fossilen Insekten," the Tertiary species of the world are all listed, and full references to the literature are given; but the genera are not separately indicated, and the list does not show which of the genera are extinct, nor who named them. The list now offered should therefore be useful; and it is especially commended to the attention of "recent" entomologists, who should carefully examine the genera belonging to their special groups, to see what light they throw on the classification and history of the modern fauna. It is by no means unlikely that some of the supposedly extinct genera will yet be discovered living; some indeed may already have been described, though their identity has not been recognized. It is at least suggestive that one of the fossil Dipterous genera proves to be the same as one now living in Africa.

It will be noted that most of the genera are from the Miocene of Florissant, Colorado. The Green River and some other localities are Eocene; no American Pliocene insects have been discovered.

The plan of the list is as follows: after the name of the genus follows a number indicating how many species are now known from the American Tertiaries; then comes the name of the type of the genus; and after that the locality of the type-species. The letters following the names of the type-species are as follows:

M. Monotypical genus.

MP. Monotypical genus at time of publication.

OD. Type by original designation. In the case of genera with several species, Scudder rarely indicated a type.

D. Type herewith designated. I have chosen as the type the first species, except when that species had not been figured, while some other had.

ARACHNIDA.

Attidæ.

Parattus Scudd. 3. *P. resurrectus* Scudd. D. Florissant.

Epeiridæ.

Tethneus Scudd. 4. *T. hentzii* Scudd. (in Zittel) MP. Florissant.

INSECTA.

APTERA (?).

Planocephalus Scudd 1 *P. aselloides* Scudd. M. Florissant.

ISOPTERA.

Termitidæ.

Parotermes Scudd. 3. *P. insignis* Scudd. D. Florissant.

CORRODENTIA.

Psocidæ.

Paropsocus Scudd. 1. *P. disjunctus* Scudd. M. Fossil Cañon, Utah.

NEUROPTERA.

Raphidiidæ.

Megaraphidia Ckll. 1. *M elegans* Ckll. M. Florissant.

Osmylidæ.

Osmylidia Ckll. 1. *O. requieta* (Scudd.) M. Florissant.

Chrysopidæ

Palæochrysa Scudd. 2. *P. stricta* Scudd. MP. Florissant.
Tribochrysa Scudd. 2. *T. inequalis* Scudd. (in Zittel) MP. Florissant.

Hemerobiidæ.

Bothromicromus Scudd. 1. *B. lachlani* Scudd M. Quesnel, British Columbia.

Panorpidæ.

Holcorpa Scudd. 1. *H. maculosa* Scudd. M. Florissant.

Meropidæ.

Eomerope Ckll. 1. *E. tortriciformis* Ckll. M. Florissant.

Eobanksiidæ.

Eobanksia Ckll 1. *E. bittaciformis* Ckll. M. Florissant.

ODONATA.

Agrionidæ.

Dysagrion Scudd. 3 *D. fredericii* Scudd. MP. Green River, Wyo.

Lithagrion Scudd. 1. *L. hyalinum* Scudd. D. Florissant.
Melanagrion Ckll. 2. *M. umbratum* (Scudd.) MP. Florissant.
Phenacolestes Ckll. 2. *P. mirandus* Ckll. OD. Florissant.

ÆSCHNIDÆ.

Lithœschna Ckll. 1. *L. needhami* Ckll. M. Florissant.

LIBELLULIDÆ.

Stenogomphus Scudd. 1. *S. carletoni* Scudd. M. Crest of Roan Mts., Colo.

TRICHOPTERA.

PHRYGANEIDÆ.

Limnopsyche Scudd. 1. *L. dispersa* Scudd. M. Florissant.

LIMNEPHILIDÆ.

Eopteryx Ckll. (subg. of *Platyphylax*) 1. *Platyphylax florissantensis* Ckll. M. Florissant.

ODONTOCERIDÆ.

Phenacopsyche Ckll. 1. *P. vexans* Ckll. M. Florissant.

HYDROPSYCHIDÆ.

Derobrochus Scudd. 3? *D. frigescens* Scudd. (in Zittel) MP. Florissant.
Leptobrochus Scudd. 1. *L. luteus* Scudd. M. Florissant.
Litobrochus Scudd. 1. *L. externatus* Scudd. M. Florissant.
Mesobrochus Scudd. 2. *M. lethæus* Scudd. D. Florissant.
Paladicella Scudd. 1. *P. eruptionis* Scudd. M. Florissant.

LEPIDOPTERA.

NYMPHALIDÆ.

Apanthesis Scudd. 1. *A. leuce* Scudd. M. Florissant.
Barbarothea Scudd. 1. *B. florissanti* Scudd. M. Florissant
Jupiteria Scudd. 1. *J. charon* Scudd. M. Florissant.
Lithodryas n. n.
(*Lithopsyche* Scudd. not Butler.) 1. *L. styx* (Scudd.) M. Florissant.
Nymphalites Scudd. 2. *N. obscurum* Scudd. MP. Florissant.
Prodryas Scudd. 1. *P. persephone* Scudd. M. Florissant.
Prolibythea Scudd. 1. *P. vagabunda* Scudd. M. Florissant.

PIERIDÆ.

Stolopsyche Scudd. 1. *S. libytheoides* Scudd. M. Florissant.

FAMILY UNKNOWN.

Phylledestes Ckll. 1. *P. vorax* Ckll. M. Florissant.

HYMENOPTERA.

ORYSSIDÆ.

Lithoryssus Brues. 1. *L. parvus* Brues. M. Florissant.

LYDIDÆ.

Atocus Scudd. 1. *A. defessus* Scudd. M. Florissant.

TENTHREDINIDÆ.

Lisconeura Roh. 1. *L. vexabilis* (Brues) M. Florissant.
Nortonella Roh. 1. *N. typica* Roh. M. Florissant.
Palæotaxonus Brues. 2. *P. typicus* Brues. MP. Florissant.
Paremphytus Brues 1. *P. ostentus* Brues, M. Florissant.
Phenacoperga Ckll. 1. *P. coloradensis* (Ckll.) M. Florissant.
Pseudocimbex Roh. 1. *P. clavatus* Roh. M. Florissant.
Trichiosomites Brues. 1. *T. obliviosus* Brues. M. Florissant.

STEPHANIDÆ.

Protostephanus Ckll. 1. *P. ashmeadi* Ckll. M. Florissant.

BRACONIDÆ.

Calyptites Scudd. 1. *C. antediluvianum* Scudd. M. Quesnel, British Columbia.

ICHNEUMONIDÆ.

Lithotorus Scudd. 1. *L. cressoni* Scudd. M. Green River, Wyo.

VESPIDÆ.

Palæovespa Ckll. 3. *P. florissantia* Ckll. OD. Florissant.

SCOLIIDÆ.

Geotiphia Ckll. 1.[1] *G. foxiana* Ckll. M. Florissant.
Lithotiphia Ckll. 1. *L. scudderi* Ckll M. Florissant.

POMPILIDÆ.

Ceropalites Ckll. 1.[1] *C. infelix* Ckll. M. Florissant.

PHILANTHIDÆ.

Prophilanthus Ckll. 1. *P. destructus* Ckll. M. Florissant.

NYSSONIDÆ.

Hoplisidia Ckll. 1. *H. kohliana* Ckll. M. Florissant.

APIDÆ (sens. lat.).

Calyptapis Ckll. 1. *C. florissantensis* Ckll. M. Florissant.
Cyrtapis Ckll. 1. *C. anomalus* Ckll. M. Florissant.
Libellulapis Ckll. 1. *L. antiquorum* Ckll. M. Florissant.

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[1] Mr. Rowland E. Turner (in litt.) expresses the opinion that *Geotiphia* may be found to include a number of living South American species, hitherto referred to *Anthobosca*. *A. iheringii* Sauss. he thinks especially close to the fossil genus. True or typical *Anthobosca* is Australian.

Lithandrena Ckll. 1. *L. saxorum* Ckll. M. Florissant.
Pelandrena Ckll. 1. *P. reducta* Ckll. M. Florissant.
Protomelecta Ckll. 1. *P. brevipennis* Ckll. M. Florissant.

ORTHOPTERA.

Forficulidæ.

Labiduromma Scudd. 10. *L. avia* Scudd. D. Florissant.

Gryllidæ.

Lithogryllites Ckll. 1. *L. lutzii* Ckll. M. Florissant.
Pronemobius Scudd. 3. *P. induratus* Scudd. D. Green River, Wyo.

Mantidæ.

Lithophotina Ckll. 1 *L. floccosa* Ckll. M. Florissant.

Locustidæ.

Lithymnetes Scudd. 1. *L. guttatus* Scudd. M. Florissant.
Palæorehnia Ckll. 1. *P. maculata* Ckll. M. Florissant.

Acridiidæ.

Nanthacia Scudd. 1 *N. torpida* Scudd. M. Florissant.
Taphacris Scudd. 1. *T. reliquata* Scudd. M. Florissant.
Tyrbula Scudd. 2 *T. multispinosa* Scudd. D. Green River, Wyo.

HOMOPTERA.

Cicadidæ.

Lithocicada Ckll. 1. *L. perita* Ckll. M. Florissant.

Fulgoridæ.

Diaplegma Scudd. 7. *D. abductum* Scudd. D. Florissant.
Ficarasites Scudd. 1. *F. stigmaticum* Scudd. M. Green River, Wyo.
Florissantia Scudd. 1. *F. elegans* Scudd. M. Florissant.
Hammapteryx Scudd. 1. *H. reticulata* Scudd. M. Green River, Wyo.
Lithopsis Scudd. 2. *L. fimbriata* Scudd. MP. Green River, Wyo.
Nyctophylax Scudd. 2. *N. uhleri* Scudd. OD. Florissant.
Oliarites Scudd. 1. *O. terrentula* (Scudd.) M. Green River, Wyo.
Planophlebia Scudd. 1. *P. gigantea* Scudd. M. Similkameen River, B. C.

Jassidæ.

Docimus Scudd. 1. *D. psylloides* Scudd. M. Florissant.
Jassopsis Scudd. 1. *J. evidens* Scudd. M. Florissant.

Cercopidæ.

Cercopites Scudd. 2. *C. umbratilis* Scudd. D. Green River, Wyo.
Lithecphora Scudd. 4. *L. setigera* Scudd. D. Florissant.

Locrites Scudd. 2.[1] *L. copei* Scudd. D. Florissant.
Palaphrodes Scudd. 5. *P. cincta* Scudd. D. Florissant.
Palecphora Scudd. 6. *P. maculata* Scudd. D. Florissant.
Petrolystra Scudd. 2. *P. gigantea* Scudd. D. Florissant.
Prinecphora Scudd. 1. *P. balteata* Scudd. M. Florissant.

Psyllidæ.

Catopsylla Scudd. 1. *C. prima* Scudd. M. Florissant.
Necropsylla Scudd. 1. *N. rigida* Scudd. M. Florissant.

Aphididæ.

Amalancon Scudd.[2] 1. *A. lutosus* Scudd. M. Florissant.
Anconatus Buckt. 3. *A. dorsuosus* Buckt. MP. Florissant.
Aphantaphis Scudd. 1. *A. exsuca* Scudd. M. Florissant.
Aphidopsis Scudd. 6. *A. margarum* Scudd. D. Florissant.
Archilachnus Buckt. 2. *A. pennatus* Buckt. MP. Florissant.
Cataneura Scudd. 2. *C. absens* Scudd. D. Florissant.
Gerancon Scudd.[2] 2. *G. petrorum* (Scudd.) D. Quesnel, B. C.
Lithaphis Scudd. 1. *L. diruta* Scudd. M. Florissant.
Oryctaphis Scudd. 2. *O. recondita* Scudd. D. Florissant.
Pterostigma Buckt. 2. *P. recurvum* Buckt. MP. Florissant.
Sbenaphis Scudd. *S. quesneli* (Scudd.) D. Quesnel, B. C. (also Florissant).
Schizoneuroides Buckt. 1. *S. scudderi* Buckt. M. Florissant.
Siphonophoroides Buckt. 3. *S. antiqua* Buckt. MP. Florissant.
Sychnobrochus Scudd. 1. *S. reviviscens* Scudd. M. Florissant.
Tephraphis Scudder 2. *T. simplex* (Buckt.) D. Florissant.

HETEROPTERA.

Corixidæ.

Prosigara Scudd. 1. *P. flabellum* Scudd. M. Florissant.

Galgulidæ.

Necygonus Scudd. 1. *N. rotundatus* Scudd. M Grêen River, Wyo.

Veliidæ.

Palæovelia Scudd. 1. *P. spinosa* Scudd. M. Florissant.
Stenovelia Scudd. 1. *S. nigra* Scudd. M. Florissant.

Hydrobatidæ.

Telmatrechus Scudd. 2. *T. stâli* (Scudd.) D. Similkameen River, B. C.

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[1] A third species, *Locrites haidingeri* (Heer), occurs in the Lower Miocene at Radoboj, Croatia.

[2] In Scudder's table of genera, which has priority of place over the detailed descriptions, *Amalancon* and *Gerancon* are called *Amalanchum* and *Geranchum*. No species are there referred to them, however.

Reduviidæ.

Eothes Scudd. 1. *E. elegans* Scudd. M. Florissant.
Tagalodes Scudd. 1. *T. inermis* Scudd. M. Florissant.

Tingididæ.

Eotingis Scudd. 1.[1] *E. antennata* Scudd. D. Florissant.

Capsidæ.

Aporema Scudd. 1. *A. præstrictum* Scudd. M. Florissant.

Lygæidæ.

Catopamera Scudd. 2. *C. augheyi* Scudd. D. Florissant.
Cophocoris Scudd. 1. *C. tenebricosus* Scudd. M. Florissant.
Coptochromus Scudd. 1. *C. manium* Scudd. M. Florissant.
Cryptochromus Scudd. 1. *C. letatus* Scudd. M. Florissant.
Ctereacoris Scudd. 1. *C. primigenus* Scudd. M. Florissant.
Eucorites Scudd. 1. *E. serescens* Scudd. M. Florissant.
Exitelus Scudd. 1. *E. exsanguis* Scudd. M. Florissant.
Linnæa Scudd. 6. *L. holmesii* Scudd. D. Florissant.
Lithochromus Scudd. 4. *L. gardneri* Scudd. D. Florissant.
Lithocoris Scudd. 1. *L. evulsus* Scudd. M. Florissant.
Necrochromus Scudd. 3. *N. cockerelli* Scudd. D. Florissant.
Phrudopamera Scudd. 2. *P. wilsoni* Scudd. D. Florissant.
Procoris Scudd. 2. *P. bechleri* Scudd. D. Florissant.
Procrophius Scudd. 3. *P. communis* Scudd. D. Florissant.
Prolygæus Scudd. 1. *P. inundatus* Scudd. M. Florissant.
Stenopamera Scudd. 2. *S. tenebrosa* Scudd. D. Florissant.
Tiromerus Scudd. 2. *T. torpefactus* Scudd. OD. Florissant.

Coreidæ.

Achrestocoris Scudd. 1. *A. cinerarius* Scudd. M. Florissant.
Cacalydus Scudd. 2. *C. lapsus* Scudd. D. Florissant.
Etirocoris Scudd. 1. *E. infernalis* Scudd. M. Florissant.
Heeria Scudd. 3 *H. gulosa* Scudd. D. Florissant.
Orthriocorisa Scudd. 1. *O. longipes* Scudd. M. Florissant.
Parodarmistus Scudd. 6. *P. abscissus* Scudd. D. Florissant.
Phthinocoris Scudd. 4. *P. colligatus* Scudd. D. Florissant.
Piezocoris Scudd. 3. *P. peritus* Scudd. D. Florissant.
Rhepocoris Scudd. 5. *R. prævalens* Scudd. D. Florissant
Tenor Scudd. 1. *T. speluncæ* Scudd. M. Florissant.

Cydnidæ.

Necrocydnus Scudd. 8. *N. amyzonus* Scudd D. Florissant.
Procydnus Scudd. 8. *P. pronus* Scudd. D. Florissant.
Stenopelta Scudd. 1. *S. punctulata* (Scudd.) M. Green River, Wyo.
Thlibomenus Scudd. 5. *T. parvus* Scudd. D. Florissant.

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[1]A second species, *Eotingis quinquecarinata* (Germ.-Ber.), occurs in Baltic amber.

Pentatomidæ.

Cacoschistus Scudd. 1. *C. maceriatus* Scudd. M. Florissant.
Matæoschistus Scudd. 1. *M. limigenus* Scudd. M. Florissant.
Pentatomites Scudd. 1.[1] *P. foliarum* Scudd. M. Florissant.
Polioschistus Scudd. 2. *P. ligatus* Scudd. D. Florissant.
Poteschistus Scudd 1. *P. obnubilus* Scudd. M. Florissant.
Teleoschistus Scudd. 3. *T. antiquus* (Scudd.) D. Quesnel, British Columbia.
Thlimmoschistus Scudd. 1. *T. gravidatus* Scudd. M. Florissant.
Thnetoschistus Scudd. 1. *T. revulsus* Scudd. M. Florissant.
Tiroschistus Scudd. 1. *T. indurescens* Scudd. M. Florissant.

THYSANOPTERA.

Lithadothrips Scudd. 1. *L. vetusta* Scudd. M. Fossil Cañon, White R., Utah.
Palæothrips Scudd. 1. *P. fossilis* Scudd. M. Fossil Cañon, White R., Utah.

DIPTERA.

Tipulidæ.

Cladoneura Scudd. 1 *C. willistoni* Scudd. M. Florissant.
Cyttaromyia Scudd. 5. *C. fenestrata* Scudd. MP. White River, Utah.
Limnocema Scudd. 4. *L. marcescens* Scudd. D. Florissant.
Manapsis Scudd. 1. *M. anomala* Scudd. M. Florissant.
Micrapsis Scudd. 1. *M. paludis* Scudd. M. Florissant
Oryctogma Scudd. 1. *O. sackenii* Scudd. M. Florissant.
Pronophlebia Scudd. 1. *P. rediviva* Scudd. M. White R., near Colo.–Utah boundary.
Rhadinobrochus Scudd. 1. *R. extinctus* Scudd. M. Florissant.
Spiladomyia Scudd 1. *S. simplex* Scudd. M. Chagrin Valley, White R., Colo.
Tipulidea Scudd. 4. *T. picta* Scudd. D. Florissant.

Cecidomyidæ.

Lithomyza Scudd. 1. *L. condita* Scudd. M. Chagrin Valley, White River, Colo.

Mycetophilidæ.

Mycetophætus Scudd. 1 *M. intermedius* Scudd. M. Florissant.
Sackenia Scudd. 2. *S. arcuata* Scudd. MP. Chagrin Valley, White River, Colo.

Blepharoceridæ.

Philorites Ckll. 1. *P. johannseni* Ckll. M. Near Rifle, Colo. (Eocene).

Stratiomyidæ.

Asarcomyia Scudd. 1. *A cadaver* Scudd. M. Green River, Wyo.
Lithophysa Scudd. 1. *L. tumulta* Scudd. M. Green River, Wyo.

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[1] *Pentatomites* was proposed for obscure Pentatomids of uncertain generic position, and is therefore strictly a pseudogenus, without a type.

NEMESTRINIDÆ.

Palembolus Scudd. 1. *P. florigerus* Scudd. M. Florissant.

ASILIDÆ.

Stenocinclis Scudd. 1. *S. anomala* Scudd. M. Green River, Wyo.

BOMBYLIIDÆ.

Alepidophora Ckll. 1. *A. pealei* Ckll. M. Florissant.
Lithocosmus Ckll. 1. *L. coquilletti* Ckll. M. Florissant.
Megacosmus Ckll. 1. *M. mirandus* Ckll. M. Florissant.
Melanderella Ckll. 1. *M. glossalis* Ckll. M. Florissant.
Pachysystropus Ckll. 1. *P. rohweri* Ckll. M. Florissant.

CONOPIDÆ.

Poliomyia Scudd. 1. *P. recta* Scudd. M. Green River, Wyo.

ORTALIDIDÆ.

Lithortalis Scudd. 1. *L. picta* Scudd. M. Quesnel B. C.

GLOSSINIDÆ.

Palæstrus Scudd. 1.[1] *P. oligocenus* Scudd. M. Florissant.

COLEOPTERA.

CARABIDÆ.

Neothanes Scudd. 1. *N. testeus* (Scudd.) M. Green River, Wyo.

STAPHYLINIDÆ.

Laasbium Scudd. 2. *L. agassizii* Scudd. D. Florissant.
Staphylinites Scudd. 1.[2] *S. obsoletum* Scudd. M. Green River, Wyo.

CUCUJIDÆ.

Lithocoryne Scudd. 1. *L. gravis* Scudd. M. Florissant.

NITIDULIDÆ.

Epanuræa Scudd. 1. *E. ingenita* Scudd. M. Florissant.

BYRRHIDÆ.

Nosotetocus Scudd. 3. *N. marcovi* Scudd MP. Florissant.

ELATERIDÆ.

Adocetus Scudd. 1. *A. buprestoides* Scudd. M. Fossil, Wyo.

CERAMBYCIDÆ.

Parolamia Scudd. 1. *P. rudis* Scudd. M. Florissant.

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[1]*Paloestrus* is a synonym of *Glossina*, a genus still living, but confined to Africa and S. Arabia.

[2]*Staphylinites* is a pseudogenus for obscure Staphylinids, and strictly speaking has no type.

Chrysomelidæ.

Cryptocephalites Scudd. 1. *C. punctatus* Scudd. M. Similkameen R., B. C.
Oryctoscirtetes Scudd. 1. *O. protogæum* Scudd. M. Florissant.

Rhynchitidæ.

Docirhynchus Scudd. 1. *D. terebrans* Scudd. D. Florissant.
Isothea Scudd. 1. *I. alleni* Scudd. M. Florissant.
Masteutes Scudd. 2. *M. rupis* Scudd. D. Florissant.
Paltorhynchus Scudd. 3. *P. narwhal* Scudd. D. Florissant.
Steganus Scudd. 1. *S. barrandei* Scudd. M. Roan Mts., Colo.
Teretrum Scudd. 2. *T. primulum* Scudd. D. Florissant.
Toxorhynchus Scudd. 2. *T. minusculus* Scudd. OD. Florissant.
Trypanorhynchus Scudd. 3. *T corruptivus* Scudd. D. Florissant

Otiorhynchidæ.

Eucryptus Scudd. 1. *E. sectus* Scudd. M. Florissant.
Eudomus Scudd. 2. *E. robustus* Scudd. D. Florissant.
Evopes Scudd. 2. *E. veneratus* Scudd. D. Florissant.
Ophryastites Scudd. 4.[1] *O. absconsus* Scudd. D. Florissant.
Tenillus Scudd. 1. *T. firmus* Scudd. M. Florissant.

Curculionidæ.

Catobaris Scudd. 1. *C. cœnosa* Scudd. M. Florissant.
Centron Scudd. 1. *C. moricollis* Scudd. M. Florissant.
Cremastorhynchus Scudd. 1. *C. stabilis* Scudd. M. Florissant.
Eocleonus Scudd. 1. *E. subjectus* Scudd. M. Florissant.
Geralophus Scudd. 9. *G. antiquarius* Scudd. D. Forissant.
Laccopygus Scudd. 1. *L. nilesii* Scudd. M. Florissant.
Limalophus Scudd. 2. *L. compositus* Scudd. D. Green River, Wyo., (also White River, Utah).
Numitor Scudd. 1. *N. claviger* Scudd. M. Florissant.
Rhysosternum Scudd. 2. *R. longirostre* Scudd. D. Florissant.
Smicrorhynchus Scudd. 1. *S. macgeei* Scudd. M. Florissant.

Calandridæ.

Calandrites Scudd. 2. *C. defessus* Scudd. D. Roan Mts., Colo. (also Green River, Wyo.).
Lithophthorus Scudd. 1. *L. rugosicollis* Scudd. M. Florissant.
Oryctorhinus Scudd. 1. *O. tenuirostris* Scudd. M. Florissant.
Sciabregma Scudd. 1. *S. rugosa* Scudd. M. Roan Mts., Colo.
Spodotribus Scudd. 1. *S. terrulentus* Scudd. M. Florissant.

Anthribidæ.

Saperdirhynchus Scudd. 1. *S. priscotitillator* Scudd. M. Florissant.
Stiraderes Scudd. 1. *S. conradi* Scudd. M. Florissant.

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[1]*Ophryastites* is a genus for obscure forms allied to *Ophryastes*. It should probably be regarded as having no type.

56.9,61M(79.8)

Article IX.—NOTES ON ALASKAN MAMMOTH EXPEDITIONS OF 1907 AND 1908.

By L. S. Quackenbush.

Plates XVII–XXV.

CONTENTS.

I. Introduction.

In the summer of 1907 the American Museum of Natural History sent the writer to Alaska primarily to examine into certain reports relative to the finding of an entire mammoth, and secondarily to make a reconnaissance in search of fossil vertebrates. A second expedition was sent out in 1908 to

continue the work already begun. These expeditions were planned by Professor Henry Fairfield Osborn and Director H. C. Bumpus. They were maintained through subscription of two of the trustees of the Museum, Messrs. J. Pierpont Morgan, Jr., and Percy R. Pyne.

During the first season the writer was accompanied as far as Nome by Mr. Madison Grant, Secretary of the New York Zoölogical Society, to whom he is much indebted for taking a personal interest in the expedition and rendering assistance in many ways. Special thanks are also due to Mr. C. R. Corbusier for the use of his canoe to make an excursion to the Palisades on the Yukon River, and to Mr. T. C. Noyes of Candle, Alaska, who loaned the only light boat in that region and without which it would have been impossible to make any progress on the rivers flowing into Eschscholtz Bay. A fine bison skull was donated to the Museum by Mr. George T. Coffey, through whose kindness the writer was enabled to examine the mine where it was found; and excellent specimens of fossil horse and bison teeth were presented by Mr. Arthur Gibson, C. E., Mr. George T. Reichenbach, Mr. W. S. Thompson, and Mr. Curtt H. Evern.

Map II (Plate XXV), showing the distribution of Pleistocene mammal deposits in Alaska and the Klondike region, has been plotted from all available sources of information and is practically complete[1] to date. Professor Henry Fairfield Osborn furnished records of several new localities as well as a map made, at his request, through the kindness of Dr. William H. Dall. The writer is indebted to Professor James F. Kemp for the identification and discussion of some samples of rock and silt from Eschscholtz Bay, and to Dr. Arthur Hollick who has undertaken the study of some specimens of Pleistocene plants from the same locality. Mrs. Elizabeth G. Britton has been kind enough to determine several mosses taken from the silts at Elephant Point and on the Buckland River. The assistance of Mr. Walter Granger, of the Museum staff, in the determination of fossils and in other ways has been greatly appreciated.

II. Itinerary.

We left New York on July 5, 1907, proceeding via Seattle and Skagway to White Horse, at the head of navigation on the Yukon River, and arrived at Dawson on July 19. Three days were spent in and about Dawson

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[1] A reported occurrence (Nome Semi-Weekly Nugget) of mammoth remains on Snow River, at the head of Lake Kenai, Kenai Peninsula, Alaska, has been omitted. See also accounts of bones of mammoth and bear on the Pribilof Islands: Dall (3), p. 858; Dall and Harris, p. 266; Stanley-Brown, p. 499; Lucas (1), p. 718; and of mammoth teeth and tusks on Unalaska Island: Stein, pp. 382, 383. (For literature see appendix.)

examining several collections of fossils which had been found in this vicinity; we then continued our journey and reached Fort Gibbon on July 25. From here Mr. Grant visited Fairbanks while the writer made a trip in a canoe to a high cut bank, known as the Palisades, on the Yukon River thirty-five miles below the mouth of the Tanana. Four days later we met again on a river steamer and proceeded to St. Michaels, several stops giving an opportunity to examine a number of fossils which had been brought to the small settlements along the Yukon. On August 4 we departed from St. Michaels on a tug and a fifteen hour run took us to Nome where Mr. Grant left the expedition. The writer spent five days in and near Nome and also made a short trip up the Solomon River, thirty miles east.

The persons concerned in the reported mammoth find would make no reasonable agreement as to showing the body and, feeling pretty well satisfied that there was nothing in their various stories, it was decided to visit the well known fossil deposit on Eschscholtz Bay. On August 13 the writer left Nome on the steamer 'Corwin' and sailed to Keewalik at the eastern end of Kotzebue Sound, from here visiting Candle, a few miles up Keewalik River, and then returning to 'the spit.'

As there is no regular means of travel north of Keewalik it becomes absolutely necessary in exploring this region to have two boats — one adapted to coasting, and a canoe for use on the rivers. In this part of Alaska quick travelling on rapid rivers is not understood hence light river-boats are not to be found and a clumsy, waterlogged canoe was finally secured only by chance. For cook and helper, the services of James Hoffman were engaged and his fishing boat hired for the coasting; Keewalik's three launches were under contract and could not be procured at any price. Unfortunately the boat was not fitted with a centerboard, which made it impossible to sail in any wind ahead of the beam and caused considerable loss of time.

After several unavoidable delays we got away from Keewalik on August 24 and proceeded first to Elephant Point. From two camps near the point we searched the bluffs on the south side of Eschscholtz Bay, and the cut banks on the lower part of Lost River. On September 1 we entered the Buckland River but ascended only fifteen miles for it had become evident that, owing to the unusually early fall, it would not have been possible to make a thorough exploration in the short time remaining. We therefore turned about and went to the Ah-weeng-nuk River which enters the northeastern corner of Eschscholtz Bay; this small stream was explored for twenty miles or more but only three bones were found and it did not seem worth while to go any further. The bluff on the north side of Eschscholtz Bay was next examined from one end to the other. Adverse winds and an exceptionally heavy gale, which lasted three days, having put an end to the

idea of further exploration, we sailed to Elephant Point and went over this ground once more. Several fossils had been washed out of the bluff during our absence, and some interesting results of the storm are noted below.

On September 19 there was considerable ice around the edge of the Bay, the bluff had begun to freeze, and even the exposed clay flat was solid; upon returning to Keewalik it was found that mining operations in the interior had ceased and that nothing more could be accomplished. Passage was therefore secured on the first trip of the 'Corwin' to Nome and thence on the first boat to Seattle, but owing to the inevitable delays in Alaskan travel New York was not reached until November 2.

During this expedition portions of a mammoth skeleton together with some skin and hair, were found imbedded in the bluff near Elephant Point in such a manner as to afford very good reasons for the belief that the entire skeleton, with a large part of the covering, would be found in place. In 1908 the writer was sent on a second expedition the main object of which was the excavation of this specimen, but also to make such further reconnaissance as time would permit. Accordingly he left New York toward the end of May, proceeding to Seattle and thence direct to Nome where he arrived on June 21 after ten days' delay in the ice. Seward Peninsula was crossed by train as far as Shelton and by wagon the rest of the way to Candle. Here James Hoffman, with his fishing boat, was again engaged, and we rowed down the river to Keewalik where an outfit was purchased for a preliminary trip to Elephant Point, the writer expecting to return to Candle for another assistant and a steam thawing apparatus.

We left Keewalik on July 1 and reached Elephant Point on the third, having worked through pack-ice which closed up immediately after our arrival and did not finally break up and blow out of Eschscholtz Bay until the tenth. Excavation was commenced with picks and a few days' work proved the skeleton to be incomplete; we therefore continued digging and were able, by very hard labor, to get out all the remains by hand. After going over the ground near Elephant Point we crossed the bay to examine the bluffs near Choris Peninsula, and then returned to Keewalik. In the meantime the first boat of the season had arrived and delivered a light canoe which had been shipped to this place.

On July 20 we left Keewalik in the dory, with the canoe in tow, and two days later anchored eight miles up Buckland River. From here the river was ascended in the canoe to a point about eighty-six miles above the mouth but the water was so low, on account of a drouth, that no further progress could be made. Returning to Eschscholtz Bay we again examined the bluffs along the south side, and then crossed to the north shore about opposite Elephant Point; leaving the boats in a safe spot we walked, with light packs,

Fig. 1. Bison skulls from the muck of Fox Gulch.

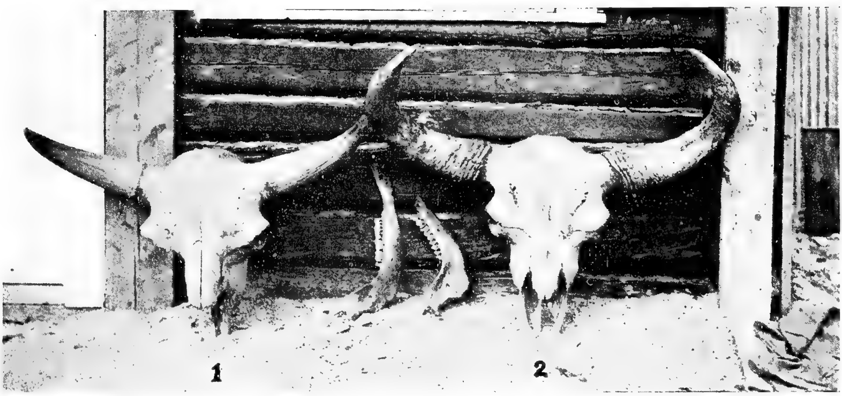

Fig. 2. Two of the skulls shown in Fig. 1.

across the narrow peninsula and spent several days along the southern shore of Selawik Lake and the southern and western shores of Hotham Inlet. Recrossing the peninsula to Eschscholtz Bay, we sailed back to Keewalik on August 20.

The writer returned by boat to Nome and Seattle, and arrived in New York on September 23.

III. Fox Gulch,[1] Klondike District, Canada.

Fox Gulch is a short, steep draw, worn down into solid bed-rock, containing in ordinary seasons a small stream flowing into the left side of Bonanza Creek, a tributary of Klondike River. Upon the bed-rock there rests from four inches to four feet of gravel which is covered with twenty feet or more of muck capped with the tundra. Some layers of pure ice are exposed in the muck.

A small mammoth tusk was seen projecting from this deposit just above the gravel, near the head of the gulch, and the radius of a large bear was found within a few feet of it, on the same level. Thirty-three bison bones and one fragmentary pelvis of a horse were collected on the 'tailings,' or washed gravel, below the mine. A collection of fossils preserved here consisted of a mammoth skull, two molars, and several imperfect tusks; also seven bison skulls and two separate rami of the lower jaws (containing the teeth) of animals of the same genus. Two of the skulls were almost complete: of these one retained the horn-sheaths in good condition, the other (No. 13721, Am. Mus. Nat. Hist. See skull numbered 1, Plate XVII, Figs. 1 and 2) contained three teeth. Four of the remaining skulls were apparently of the same species, *Bison* (*occidentalis* ?), while the seventh skull had slenderer and straighter horn cores.

Mr. George T. Coffey, who has charge of the hydraulicing operations, gave the information that all the fossils are found, in a small area near the head of the gulch, lying in the muck on the top of the gravel or partly imbedded in the latter.

Pleistocene mammals found in Fox Gulch: — *Elephas*, *Ursus*, *Equus*, *Bison*, and *Alce*.[2]

IV. The Palisades, Yukon River.

A high, cut bank on the Yukon River, thirty-five miles below the mouth of the Tanana, has been described in detail by several geologists [3] under the

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[1] See Gilmore, pp. 15–17.

[2] Gilmore, p. 15.

[3] Russell, p. 122. Spurr, pp. 200–221. Collier, (2), pp. 18, 43. Maddren, pp. 17–18. Gilmore, pp. 17–22.

name "Palisades," or "Bone-yard." Only a few scattered and fragmentary bones of the mammoth and bison were seen here, a collector having been over the ground shortly before the writer's arrival.

Pleistocene mammals recorded at the Palisades: — *Elephas, Bison, Equus,*[1] *Ovibos yukonensis.*[2]

V. Nome Coastal Plain.

Marine shells are abundant in the Quaternary deposits of the Nome coastal plain, but no mammalian remains have hitherto been recorded from this locality[3] though they are found in the coastal plain deposits on the Arctic side of Seward Peninsula. With the exception of some badly decayed fragments of bone (whale ribs?) from the third beach line, only the following specimens were seen: — small piece of walrus tusk, said to have been found in the 'pay sand' on Center Creek, 55 ft. below the surface; part of a caribou antler, also from Center Creek, 72 ft. below the surface; and a complete walrus skull with the teeth and 8-inch tusks.

This skull was found by a miner who states that it was dug out of a prospect hole on the second beach line, three quarters of a mile back of the present beach, one mile east of Fort Davis, near Nome. The section was given as follows: — tundra 2 ft.; gravel, rocks, and muck 25 ft.; gray sand 18 in.; ruby pay sand 6 in.; gray sand 2 ft.; ruby pay sand 8 in.; clay bed-rock. This entire section was frozen solid, and the skull lay in the lowest layer of ruby pay sand. A number of bones were found close to the skull and the prospector believes that much of the flesh was also preserved (although he did not actually see it) since the steam thawing caused a "horrible stench." The prospect had been abandoned and, owing to the caving in of the walls of the pit, could not be examined. The skull was not much discolored and retained no traces of skin or flesh; in its cavities, however, was a quantity of sand containing many plainly visible particles of gold.

It is known that thawing muck often gives off strong odors which are entirely due to decaying vegetable matter, and the preservation of flesh here is doubtful.

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[1] Gilmore, p. 31.
[2] Gilmore, pp. 19, 35. Gidley, p. 681.
[3] Collier, Hess, Smith, and Brooks, p. 87.

VI. Keewalik River, Alder Creek, and Native Gulch.[1]

Candle Creek, a branch of Keewalik River, has been pretty well prospected and fossils have been taken from both valley- and bench-claims. The miners agreed in stating that the fossils are found deep in frozen muck or resting on underlying broken schist bed-rock or gravels, or occasionally imbedded in the gravels. All the specimens seen were in good condition and not at all waterworn, but there seems to be no authentic record of the finding of skeletal parts in association. Isolated bones, teeth, etc., have also been collected in the upper part of Keewalik River, and a musk-ox[2] skull is recorded from a tributary called Quartz Creek.

Keewalik Lagoon, or estuary, is bordered on both sides by silt bluffs about 15 ft. high; on the beaches at the foot of the bluffs there were found a few remains, for the most part fragmentary, of mammoth, bison, and caribou. It might be assumed that these fossils had been washed down Keewalik River and transported to the shores of the lagoon by ice, but a mammoth tusk has been found projecting from the bluff on the west side of the estuary, and, during the summer of 1908, the lower jaw of a mammoth was dug from the muck bank of a branch of Minnehaha Creek which flows into the lagoon near Keewalik. Fossils have been recorded from other places in the coastal plain deposits of the north side of Seward Peninsula, especially in the vicinity of Good Hope Bay[3] and Schismareff Inlet.[4] A trader exhibited a large mammoth tooth which he found on the Serpentine River, and stated that he had seen other teeth and tusks along the high mud banks cut by this stream; also on Schismareff Inlet near the mouth of the river.

Pleistocene mammals[5] from Keewalik River drainage basin and lagoon: — *Elephas*, *Equus*, *Bison*, *Rangifer*, and *Ovibos*.

Mr. George T. Reichenbach showed the writer two large bison horns, retaining the outer sheaths in good condition, which were found two feet below the surface, in gravel, on Alder Creek. This stream enters Kotzebue Sound about ten miles west of Keewalik. Native Gulch is a small draw, near Alder Creek, filled with fifty feet of muck resting upon gravel; two bison teeth, found here in the base of the muck, were also examined, and fragments of caribou antlers are said to occur in both localities.

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[1] See Map I (Plate XVIII).

[2] Moffit, p. 42.

[3] Moffit, p. 41.

[4] See also Gilmore and Maddren, maps.

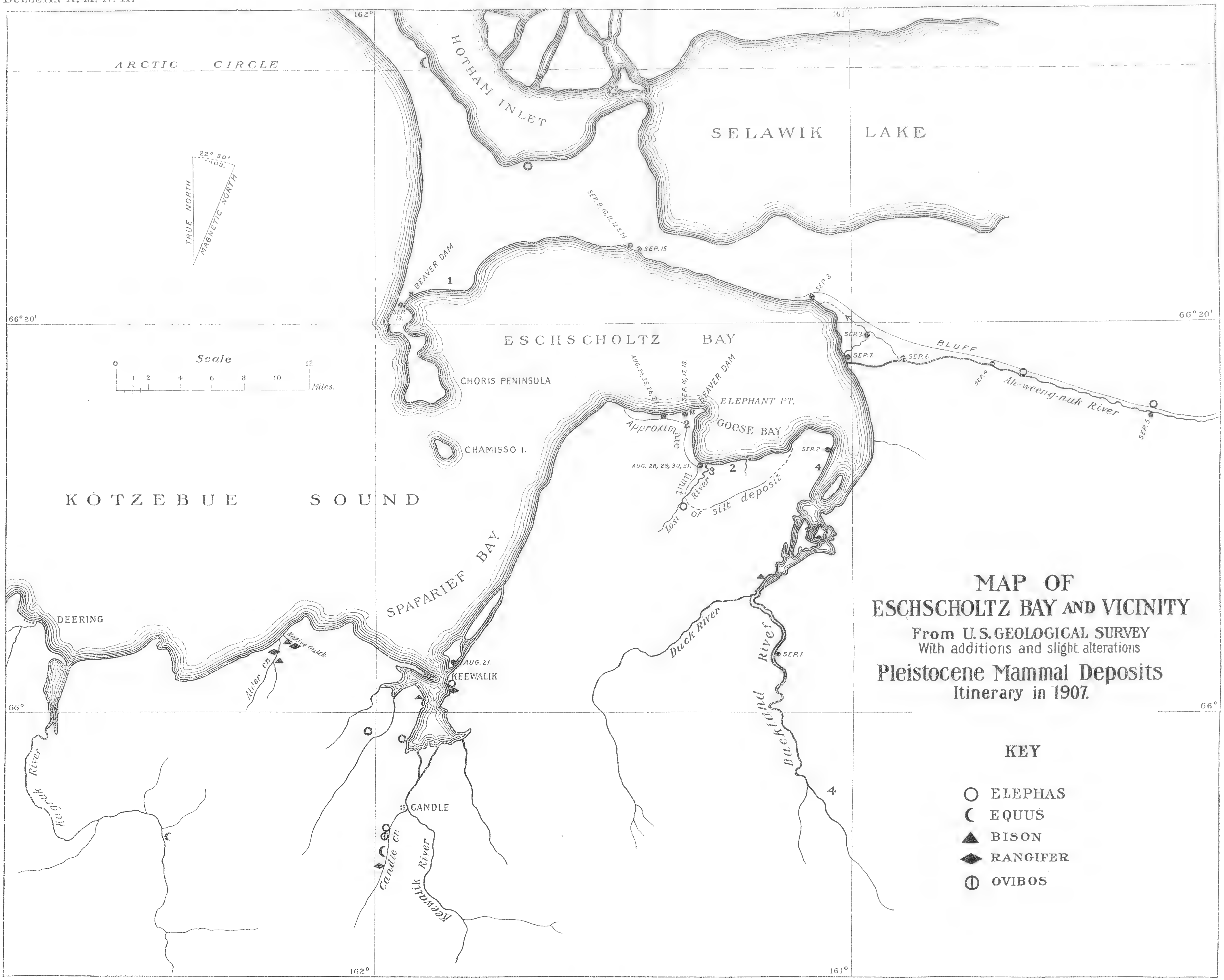
[5] A miner claims to have taken the tusks, with parts of the skull, of a "boar" from a layer of gravel, resting on bed-rock and covered with twenty feet of frozen muck, on Candle Creek. Capt. Conrad Siem, Secretary of the Alaska Pioneers Association, also states that he saw a boar tusk which was found by a native at Tasekpuk Lake, near the Arctic coast of Alaska, long. 153° W.

VII. Eschscholtz Bay.

Eschscholtz Bay (see Map, Pl. XVIII) is about twenty-five miles long, east and west, by ten miles across in a north-south direction. The channel runs from the mouth of Buckland River, at the southeastern extremity of the bay, considerably nearer the south than the north shore and splits to enter Kotzebue Sound on both sides of Chamisso Island. The whole bay is extremely shallow, the channel itself being not more than fifteen or twenty feet deep off Elephant Point.

High bluffs face the water all around except at the wide Ah-weeng-nuk delta and for a few miles to the westward of the mouth of Buckland River. Several small deltas, covered with vegetation, lie in embayments in the bluffs opposite the mouths of streams, and at other places, least affected by waves or currents, swamp-loving sedges, etc., have secured a hold on low flats formed by mud washed down from bluffs which have subsequently become entirely overgrown. Large quantities of driftwood are stranded on these deltas and flats and even for some distance up the stream valleys at a level far above an ordinary high tide; most of this wood consists of tree trunks, probably brought down from Buckland River, but it also includes lumber and wreckage. The deltas near Elephant Point are favorite camping places for Eskimos travelling to and from the river, and little driftwood has been left on them. A sloping sandy beach averaging about fifteen feet wide fringes the south shore of Eschscholtz Bay eastward to Elephant Point and southward along Goose Bay to the mouth of Lost River. The Point is a low sandspit, half a mile in length, with a broad marsh on its protected, southern side. Along the north shore, except near Choris Peninsula, the beach is steep and high, which accounts for the fact that the bluff here is not being cut away.

The tides of Eschscholtz Bay deserve mention: the rise and fall probably averages about three feet but it is so erratic that one cannot depend on calculations. Owing to the shallowness of the bay and shape of the coast local winds have an immediate effect, but there are other, unexpected, changes due to storms in the Arctic Ocean and Behring Sea. Thus southeast or southwest gales in Behring Sea produce a strong northerly current through the Strait and raise the water in Eschscholtz Bay, contrary local winds notwithstanding, several hours before the arrival of the storm wind. The slope of the bottom of Eschscholtz Bay is so gradual that at an average low tide a quarter of a mile of clay flat is exposed all around its shores; at times the tide does not drop in the least and, again, the water recedes fully a mile from the beach. We were held at camp near the mouth of Lost River for a day and a half after preparing to move by the draining of Goose Bay which remained absolutely dry for forty-eight hours.



Map I.

1 Eschscholtz Bay, north. *Elephas, Equus, Bison, Ovibos, Rangifer, Castor* (dam), *Canis* (Eskimo dog ?).

2. Eschscholtz Bay, south. (a) Historic bluff, west of Elephant Point; *Elephas, Equus, Bison, Symbos ?, Ovibos, Rangifer, Rangifer* sp. nov., *Alce, Canis* (wolf), *Ursus, Castor* (dam). (b) Goose Bay (west and south); *Elephas, Equus, Bison, Ovibos, Rangifer, Rangifer* sp. nov., *Alce.*

3. Lost River. *Elephas, Rangifer.*

4. Buckland River. *Elephas, Equus, Bison, Ovibos, Rangifer, Alce, Ursus, Canis* (wolf).

The tides are strong and no doubt carry out quantities of fine silt but erosion of the bluffs, at present, is altogether due to wave-action and atmospheric agencies. Where average high tides reach the deposits around Eschscholtz Bay steep or even perpendicular bluffs result, but the low beaches partially protect a large proportion of the cut bluffs so that waves barely wash their base and work into them only during exceptionally high water; in these places the bluffs slope back at an angle since the softened surface-layer, with its mantle of vegetation, is broken up by slides which allow further thawing, and washing by rain, to gain on wave-erosion.

a. The historic bluff.

At the entrance to Eschscholtz Bay, on the south, there is a vertical rocky cliff which terminates, about four miles from the extremity of Elephant Point, at the western margin of a Pleistocene deposit of very fine, grayish, micaceous silt, or clay. Between the rocky cliff and the base of Elephant Point is the historic, fossil-bearing bluff,[1] about three and one half miles in length, discovered by Kotzebue in 1816 and described also by several later explorers. The bluff does not end, however, at Elephant Point but bends to the south and continues around the western, and part of the southern, shores of Goose Bay.

The approximate limits of the deposit are shown on Map I (Plate XVIII) and in Fig. 1, Plate XIX. It will be seen that on Eschscholtz Bay and the western side of Goose Bay there is only a narrow strip along the base of a low ridge which is the termination of the Keewalik-Buckland divide[2]; to the south of Goose Bay the deposit extends several miles up a V-shaped valley lying between this ridge, on the west, and a spur of the divide, near Buckland River, on the east. Descriptions of the bluff west of Elephant Point are so variable and contradictory that one must come to the conclusion that rapid changes have taken place during the past century; at the present time the details of these accounts are no longer recognizable and another description is called for.

At the base of Elephant Point the bluff is about fifteen feet high rising, less than a mile to the west, to the altitude of one hundred and twenty feet and gradually descending to a height of twenty feet at the opposite end (Plate XIX, Fig. 2). Several small streams have cut deep valleys well back

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[1] See Maddren. In an appendix (pp. 67–113) Maddren gives a list of the literature on this deposit, and a complete series of extracts. Since the latter are collected in a convenient form, references will be made to Maddren's paper rather than to the original works. Fig. 2, Plate VII, p. 48, is a reproduction of Kotzebue's illustration of the ice-cliff.

Seemann, Berthold. Vol. I, Botany, 1852. Plate i (view of the "ice-cliffs").

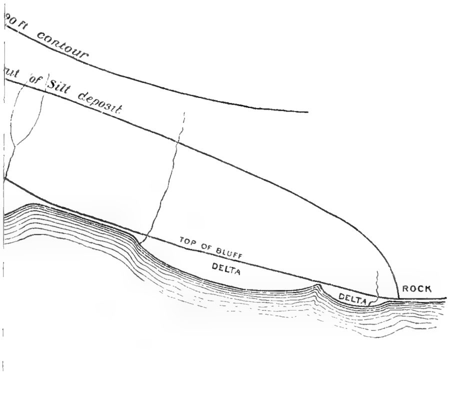
Beechey, Vol. II, Zoölogy, 1839. Plate i (geological map of Eschscholtz Bay).

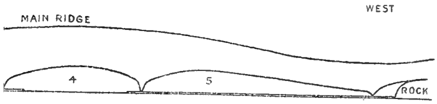
[2] See Moffit, geologic map, plate iii.

toward the ridge and divide the bluff into five main hills which, for the purpose of description, are numbered 1 to 5. (Plate XIX, Fig. 2.) Besides these streams there are several rivulets on hill 2, and two near the western end of hill 5. The two latter rivulets show, each, a small exposure, and there is another cut on the face of the 5th hill but with these exceptions the sloping faces of hills 3, 4, and 5, and the valleys between them, are completely overgrown with willows, alders, grasses, and various small flowering plants. From the top of the bluff the surface of the deposit slopes gradually upward to the ridge, where the grade becomes steeper, and the whole is covered with an unbroken carpet of tundra.[1] At the foot of the bluff, opposite the mouths of streams, there are four small deltas which are more or less swampy and support growths of alder and willow-bushes along the base of the bluff and sedges and water plants further out. Hill 1, from the beaver dam west, hill 2 entire, and the 3rd hill as far as the eastern end of the delta at its base are at present being rapidly worn away. The bluff is perpendicular only at the beaver dam and for a few yards on either side of the rivulet just west of it (Plate XIX, Figs. 1, 2, and 3), the eastern end of hill 3 is very steep, but partly overgrown with grasses, etc., and the slope of hill 2 does not average much over thirty degrees.

The face of hill 2 is very rough, being studded with knolls and ridges left standing between numerous land-slips which occur irregularly over the entire hill. There are many parallel, crescentic — or cirque-shaped — cracks, often gaping six inches in width, in and at the heads of these slides which show that the two or three feet of thawed surface is working bodily downward. A number of masses of pure ice (Plate XIX, Fig. 3) are exposed in the face of this hill, and there is usually a low-grade slope of soft, flowing or sliding mud extending for several yards below them. Four small rivulets flow down from the first rise back of the bluff through steep gulches whose sides are mostly concealed by vegetation. This rough, broken incline is almost entirely covered with a rank growth of grass from two to four feet high, the only exceptions being the fresh slides — including the soft mud slopes below the glaciers — and the scattered, small, cut surfaces above and at the sides of the glaciers and at the cut sides of some of the knolls and ridges.

[1] The characteristic tundra plant is the "Alaska cotton," a sedge growing in closely set clumps or tussocks which stand about one foot above the general level of the ground, and which make travelling in summer so difficult that it is rarely attempted except on beaten trails or by the waterways. *Sphagnum* and other mosses flourish in the meshwork of narrow spaces between the "niggerheads," as the tussocks are popularly known, and sometimes crowd out the sedges altogether. The lichen *Cladonia* grows in many places, especially on the ridges, and there is also quite a variety of low, flowering herbs. This vegetation serves, like a sponge, to retain water and make a species of 'bog' of the entire surface of the country except on the summits of high hills and mountains. The ground thaws in summer to the depth of about three feet, but when the tundra is removed thawing penetrates deeper, and the surface layer of mud begins to flow away wherever there is an outlet.





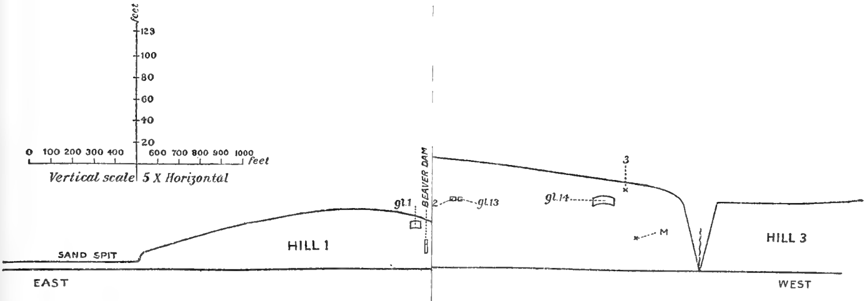
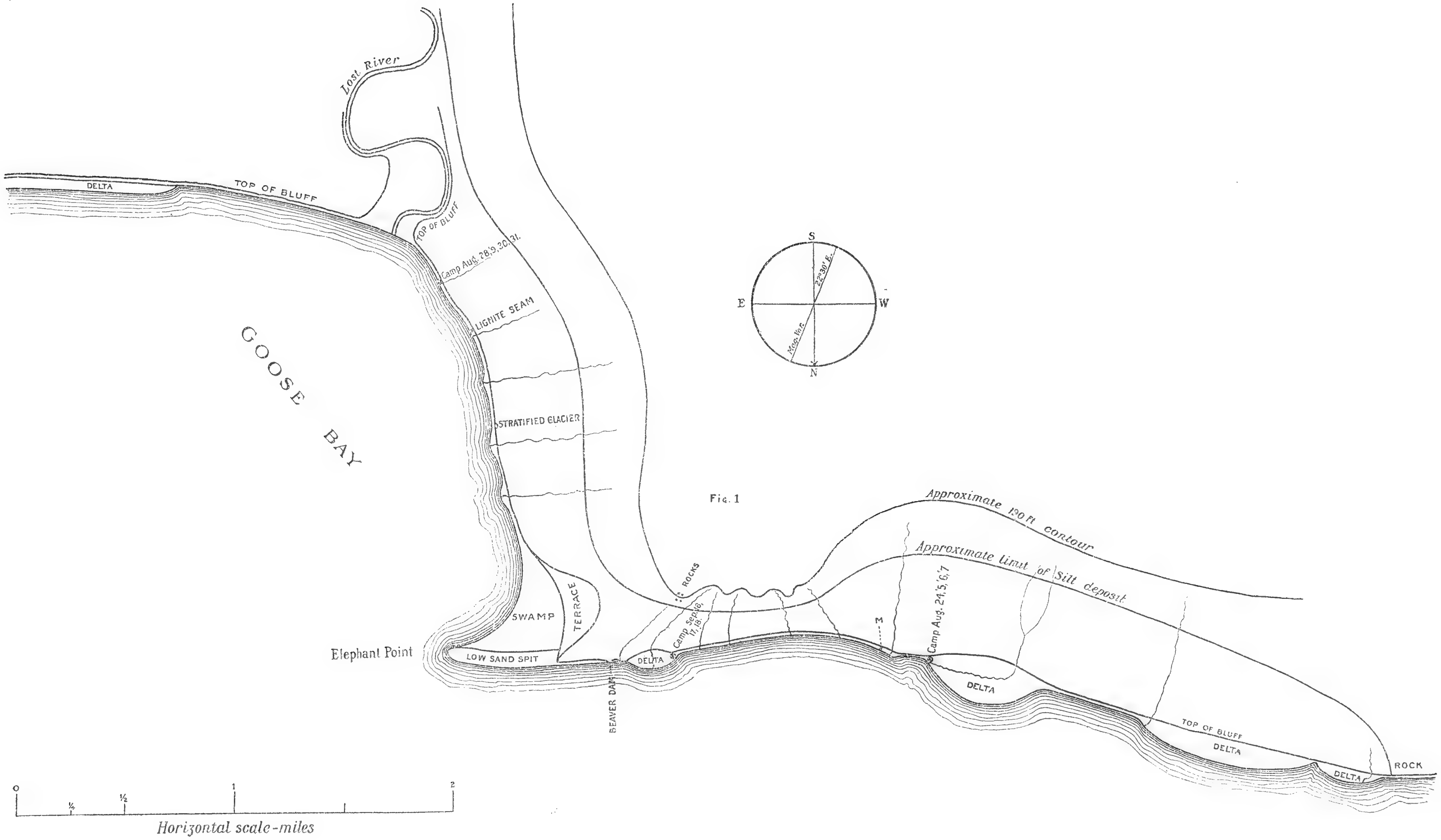
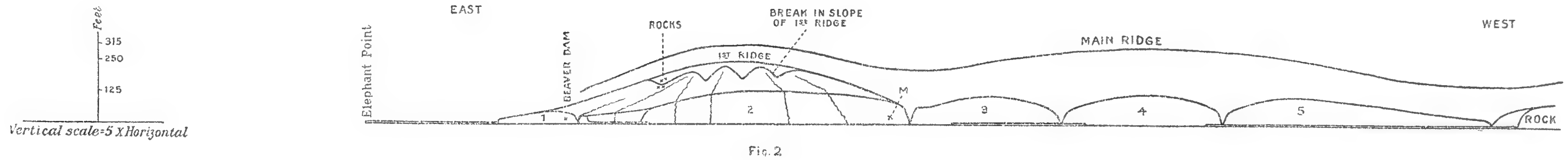


Fig. 1. Sketch map of 4.
Fig. 2. Diagrammatic caribou antler.
Fig. 3. Enlarged view
of fossils, etc., found actuall Also bones of wolf, caribou,





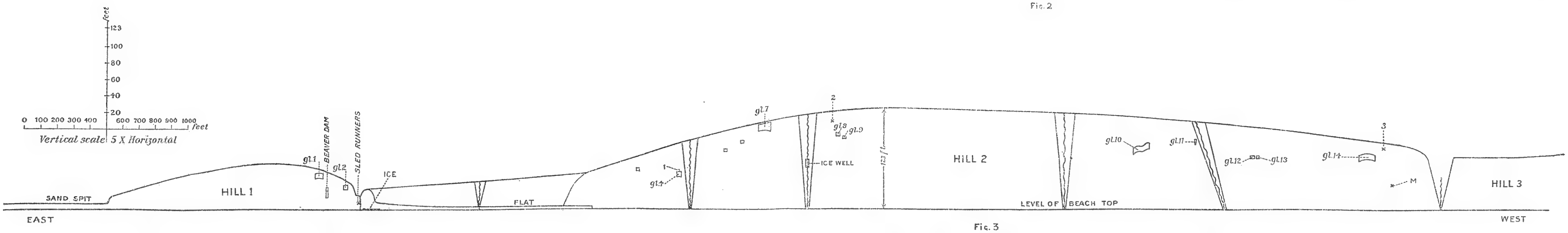


Fig. 1. Sketch map of Elephant Point and vicinity.

Fig. 2. Diagrammatic face view of the historic bluff.

Fig. 3. Enlarged view of hills 1 and 2, showing ice exposed in 1907 and location of fossils, etc., found actually imbedded in the bluff in 1907 and 1908.

1. Mammoth scapula imbedded above glacier No. 4.
2. Phalanx and two sesamoids of the horse; and caribou antler.
3. Horse astragalus.

M. Part of mammoth skeleton with skin and hair. Also bones of wolf, caribou, and horse; and small droppings.

The narrow stream between hills 2 and 3 has exposed several small, clean sections of the deposit, and numerous small angular fragments of red andesite-porphyry can be seen at the base imbedded in silt and sand. The stream-bed contains partly rounded fragments of this rock and the beach west of it as far as the neighboring delta is littered with sharply angular blocks of the same material which are falling out of the base of this portion of the bluff. Some of the blocks appear to have been broken off of polygonal columns and it is probable that they are talus-fragments from a rocky cliff, or an island, buried under the silt close to the present beach. Near the western end of hill 2 the edge of a stratum of more or less angular gravel is seen in the face of the bluff (see Figs. 3 and 4) at a height of twenty-eight feet above the beach, and a layer of coarse sand containing very fine pebbles, several feet thick, can be traced along the base of the bluff at intervals between the beaver dam and Elephant Point (see Fig. 5). Other details are described below.

A small willow tree was found imbedded in hill 1 near the beaver dam (*q. v.*). Sticks and twigs, often retaining the bark, show in some of the cut surfaces, and they are also found on the slides; the largest limb observed, which was six inches in diameter and about three feet long, appeared from the bark to be an alder while some of the smaller branches were plainly birch.

About three hundred yards back of the face of hill 2 the slope takes a sudden upward trend to the top of a hill two hundred and fifty feet above water level and from here rises more gradually to the summit of the main ridge three quarters of a mile or more from the bay. On the steep slope of the first rise there is a sharp break (Plate XIX, Fig. 2) forming a low bluff into which the heads of the rivulets of this hill are cutting back. At one point in this break a number of angular fragments of andesite-porphyry, like that of the rock-fragments mentioned above, were found weathering out through the tundra, and there seems to be no doubt that the ridge is composed of this material [1] and not "chiefly of solid ice" as Dall [2] assumed.

Remains of the following mammals [3] were found either imbedded in the historic bluff, or upon its slides, or on the beach and clay flat below: *Elephas, Equus, Bison, Symbos?, Ovibos, Rangifer, Rangifer* sp. nov., *Alce, Canis* (wolf), *Ursus, Castor* (dam).

b. Ice in the historic bluff.

Fig. 3, Plate XIX, is an enlarged, diagrammatic view of hills 1 and 2 to show the amount and distribution of the ice exposed in 1907, and the location

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[1] Cf. Moffit, geologic map, plate iii.

[2] Maddren, pp. 104, 105.

[3] The reported occurrence of fossil *Ovis* from this locality, by Seemann (see Maddren, p. 93), is an error. Gilmore, p. 36.

of the fossils, etc., found actually imbedded in their undisturbed places of deposit. It should be noted that the vertical scale is five times the horizontal scale and that the ice therefore appears five times its true proportional thickness, also that differences in level are multiplied by the same factor.[1]

There are fourteen masses of pure ice or 'glaciers,' [2] for want of a better term, exposed in these two hills, one on either side of the beaver dam in hill 1 and the rest in hill 2. The largest is about one hundred feet in length and the smallest fifteen feet; in vertical thickness they vary from one to eight feet — that is, this amount is exposed. They average about five or six feet in height in the middle and *appear* to be thinner at the ends, though they are represented in the diagram as of the same thickness throughout One (gl. 11) is a wedge-shaped mass, which may be called a 'dike,' seven feet high, two feet wide at the bottom, and five feet across the top. The faces of the glaciers are nearly vertical and as seen from above may be represented by a curved line with the concavity toward the bay. This is to be explained by the fact that the crescentic cracks caused by landslips — which cracks probably extend occasionally down into the frozen material and thus expose the ice — have the same relation to the face of the bluff Possibly the glaciers melt back more rapidly in the middle — in any case when viewed from the front they appear to be arched and thinner at the ends, since the center is further back from the sloping face of the bluff than the extremities. In walking on the soft slopes under the glaciers one sinks into the mud to the depth of a foot or more and comes to rest, below most of them, on solid ice; by tramping in the mud and pushing it away the ice can be seen and traced continuously forward from the base of the glacier for a horizontal distance often of several yards, or to a point near the foot of the mud slide. Below this point the slide is dry and firm — probably having no ice beneath it to retain the water — and takes the steeper general slope of the face of the bluff on either side of the glacier (see Figs. 1, 2, 5, and 6). The ice melts faster than the frozen material above which overhangs a foot or two and, breaking off in large lumps, falls to the base of the glacier where it quickly thaws to add to the mud. This heap of partly frozen talus protects the base of the glacier so that as the latter melts back into the bluff less and less ice remains exposed, the glacier is finally covered to the top and becoming again overgrown with grass remains dormant until a new landslip starts the melting afresh. The appearance of a number of slides suggests that this covering process has taken place and that there are, therefore, more masses of ice in the deposit than those now visible.

[1] Distances and heights, in all the figures, are estimated by pacing etc., and not measured.

[2] In Alaska the term 'glacier' is used indiscriminately by the miners to describe anything frozen — from pure ice to mud banks — and does not usually convey the idea of motion.

Fig. 1. Beaver dam imbedded in the historic bluff, seen from the west.

Fig. 2. A glacier (**G**) in hill 2, historic bluff.

One of the largest ice-layers (gl. 7, Plate XIX, Fig. 3), is situated just under the tundra though there is no sign which would indicate its presence from above. Its length is about seventy-five feet; beneath the mud slide solid ice was traced forward to the horizontal distance of thirty feet and, taking the angle of the mud slope into consideration, it appears that the entire thickness of pure ice is at least eighteen feet, of which the upper eight feet is exposed in the form of a 'glacier.'

The remaining glaciers are imbedded in the bluff at various elevations, though most of them are seen to be contained within a comparatively narrow zone toward the top of the deposit. The largest glacier observed (gl. 14, Plate XIX, Fig. 3) is about two thirds the height of the bluff above the beach; it is one hundred feet in length and its vertical face, which has the usual curved and arched form, is seven feet high in the middle and somewhat thinner at the ends. The mud slide is firmer than the average and no ice could be traced forward beneath it. Glacier no. 10 is of an irregular shape since it has been exposed by two separate slides one of which extends further up the hill than the other. Two more ice-masses to the west of Elephant Point must be described: the first is seen in the bottom of the second gulch from the eastern end of hill 2 (ice-well, Plate XIX, Fig. 3) at a distance of one hundred and twenty-five yards back of the beach. It is ten feet in thickness and its horizontal base rests on silt at an altitude of fifty feet; it is covered with ten feet of frozen mud, and the rivulet, falling from the top of this mud has worn a hole fifteen feet in diameter through the ice, running out below on the silt through a subterranean — or rather sub-ice — channel and reappearing further down in the gulch. The second ice-mass (ice, Plate XIX, Fig. 3) was exposed by a gale which raised the tide and undercut the western end of hill 1 to a depth of ten feet, showing at the back of the cut a layer of pure ice one foot thick and nearly one hundred feet long; but whether it extended downward below the level of the beach top could not be determined.

A stratified glacier consisting of alternate layers of ice and frozen muck is described below (see Figs. 1 and 2).

At present (1907), therefore, the maximum dimensions of the different glaciers are: — length (east and west, along the face of the bluff) one hundred feet; breadth (north and south, glacier no. 7) thirty feet; and vertical thickness (glacier no. 7) eighteen feet; but these are the visible or traceable dimensions and the glaciers may be more extensive. The ice is distributed in apparently isolated masses at various elevations from the beach to the top of the bluff, but some of these glaciers are very nearly on the same level and may have been connected in the portion of the bluff now washed away, and they may also be still connected within the remaining deposit. The

ice is not confined to the face of the bluff where it might have formed in cracks but in the cases of the ice-well, glacier no. 7, and the ice-layer exposed by the gale at the rear of the cut in the base of the bluff, it evidently extends back into the frozen silt.

All the water flowing from the bluff seems to come from the tundra above or from the superficial thawed layer on its face, there are no underground streams issuing from it.

In the spring and summer of 1908 there was almost no rain in this region and the snowfall of the previous winter had been very light, hence the bluff had become dryer and firmer, most of the glaciers were more or less covered, and some of the smallest had been entirely buried. On the other hand several small, new ones had appeared. Other changes noted were the complete disappearance, by melting, of the vertical exposures of the two glaciers at the sides of the beaver dam, which left clean walls of frozen silt in their places; these ice-masses could therefore not have been more than two or three feet thick (horizontally) in 1907. The stratified glacier on Goose Bay had also melted back a couple of feet and no longer contained horizontal ice-layers though the vertical ice-dike and upturned strata abutting against it were still to be seen in clean section. A very brief, chronological summary of the ice conditions in the historic bluff, as noted by all the persons [1] who have examined it, is given here for comparison: —

Aug. 8, 1816.— Bank almost perpendicular.

Pure ice 100 ft. high. (Kotzebue [2]).

July 29, 1826.—Cliff in some places vertical, in others slightly inclined (Beechey[3]). Large masses sometimes seen rent off and standing out from the body of the cliff (Collie [4]).

Only a few insignificant patches of ice remain (Beechey [5]).

Sept. 18, 1827.— Cliffs broken away considerably.

Frozen surface (ice) in smaller quantities than before (Beechey [6]).

1849.— Cliff perpendicular; structure exposed (Seemann [7]). Large chasm in bluff; great landslides; structure exposed (Goodridge [8]).

Enormous portions of ice separated from the main body. Below, ice 20-50 ft.; clay, sand, bones, 2–20 ft.; on top, peat 2–5 ft. (Seemann [9]). Ice 60 ft. high (Kellett [10]). Ice 50–80 ft. high (Goodridge [11]).

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[1] See Maddren, pp. 67–117.
[2] *Ibid.*, p. 68; and fig. 2, plate vii, p. 48.
[3] *Ibid.*, p. 69.
[4] *Ibid.*, p. 76.
[5] *Ibid.*, p. 70.
[6] *Ibid.*, p. 73.
[7] *Ibid.*, p. 92; and Seemann, Vol. I, plate i.
[8] Maddren, pp. 99, 100.
[9] *Ibid.*, pp. 92, 93.
[10] *Ibid.*, p. 102.
[11] *Ibid.*, p. 100.

July 16, 1880.— Bluff nearly perpendicular for about one mile.

Ice half a mile in length; smaller patches in several places. Ice 30 ft. thick in holes on face of bluff at top (Hooper [1]).

Sept. 2, 1880.— Cliff rough and hummocky; considerable talus.

Two layers of ice — one near beach, the other close to top. Large, perpendicular ice-faces. Immense ice-cakes irregularly disposed in the clay. (Dall [2]).

Sept. 7, 1881.— Bluff inclined and covered with talus.

Two ice-layers,— one at bottom, the other close to top. (Nelson[3]). Ice remains the same from year to year (Hooper [4]). [*Cf.* above.]

From this review it will be seen that the bluff was vertical, or nearly so, from 1816 until 1880 since which date it has become inclined, and that the ice appeared to be most abundant while the cliff was perpendicular except in 1826–27 when the ice patches were insignificant. This would seem to prove that any very deep ice-masses were comparatively thin, horizontally, and separated from one another and that they were not portions of "icebergs" as Kotzebue and Seemann imagined. Collie [5] thought that some of this deep ice was formed from snow or water in fissures more or less parallel with the face of the bluff and that it became exposed by the falling away of the retaining wall of frozen earth. In this case it would belong to the Recent period.

The surfaces of the glaciers are coated with a thin film of mud which runs down from the melting material above, but the ice within is clean though often yellow-tinged. One small, clear glacier imbedded in silt showed a distinct line of stratification running horizontally across the middle. Pieces of ice cut out from the different glaciers at a space of a foot or more from the exposed surfaces were full of round, oval, or much elongated air-bubbles or cavities. Some ice, eighteen inches thick, tapering down into a layer of gravel under the mammoth remains (i, at left, Fig. 4) was likewise vesicular and contained a few thin sheets of dirt. A vertical crack two inches wide passing between parts of this skeleton was filled with ice (i, at right, Fig. 4) which contained thin laminæ of dirt parallel to the walls; the bubbles in this ice were minute. Fragments of ice taken from the glaciers, ice-dikes, and ice-cracks melted, when exposed to the sun, so as to show a polyhedral, granular structure at the surface, and these granules could usually be easily rubbed off with the finger; they were very small, and somewhat indistinct, in the narrow, vertical crack just mentioned but in other places averaged about three sixteenths or one quarter of an inch in diameter, though in

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[1] Maddren, pp. 103, 108.
[2] *Ibid.*, pp. 104, 105.
[3] *Ibid.*, pp. 111, 112. Figure 3 (p. 112) is a section of the bluff through the beaver dam.
[4] *Ibid.*, p. 111.
[5] *Ibid.*, pp. 77, 78. *Cf.* Gilmore, pp. 20–22.

different parts of a single mass of ice they might show plainly or be apparently not formed.

Owing to the poor exposures in 1907–08 it was impossible to arrive at any final conclusions concerning the origin of the ice-masses, but a few remarks may be of interest. Some of the small glaciers may have been recently produced from snow or water in crescentic cracks at the heads of cirque-shaped slides but other glaciers are too thick, horizontally, to have been formed in this manner, moreover they are covered with the same material on which they lie and this covering is in some cases undoubtedly in an undisturbed position. At one place a mammoth scapula and some small sticks were found horizontally imbedded in silt a few inches above the middle of a layer of ice (see Figs. 8 and 9) and other mammoth bones lay at the base of the glacier, and on the slide below, making it seem probable that part of a skeleton had been buried here in a primary position of entombment. In two other places (×, Figs. 1 and 5) bones were found which must have dropped from silt above glaciers, and in one of these cases (Fig. 5) there is no doubt that the sediment had not been moved since deposition. Even the narrow ice-dike, gl. no. 11, was overlaid with silt. On the Buckland River a broad, wedge-shaped mass of ice was seen imbedded in silt which was unquestionably in its original place of deposition for the bluff above it was vertical to the top.

The fact that most of the ice at Elephant Point is imbedded in sediment differentiates it from ice-beds hitherto described in other parts of Alaska and has led Dall and others to the conclusion that it has been formed from interstratified snow-banks or frozen ponds and streams. The two ice-filled cracks exposed in excavating the mammoth skeleton were evidently formed by the infiltration of water *after* the ground had become frozen for otherwise they would not have contained laminæ of dirt parallel with the walls, moreover the vertical crack passed through the middle of the skeleton and intersected a rib. This ice is therefore comparatively new and since its granular structure was well shown, this structure is not necessarily proof of snow origin for other granular masses of ice. The ice-dike in the stratified glacier on Goose Bay was plainly formed since the deposition of the beds through which it cuts, but it may be as old as the period when the ground was originally frozen,— assuming that the freezing occurred after elevation or drainage of the deposit and not progressively as the latter was laid down. It does not seem likely that these sediments could have withstood, before freezing, the amount of undermining necessary upon the assumption that the larger ice-beds were subterranean streams; it is therefore probable that some of the ice-masses represent various forms of underground water frozen at different times ranging from the beginning of the cold period to the present,

but it is not impossible that other masses may have been interstratified on a flood-plain. On the other hand in the single case in which the contact of ice with underlying silt could be clearly seen the glacier was as clean at the bottom as everywhere else and not even a leaf or twig was to be found imbedded in it, nor in the silt; if the ice had been formed by the freezing of ponds or streams one might expect to find gravel or sticks, etc., on the bed. Since the material covering the ice is the same as that below, there is no reason to assume that it was derived from the adjacent ridge as Maddren [1] thought might be the case; in fact it is probable that this fine silt was transported from the very head of Buckland River for it contains considerable mica which is rare in andesites, of which this ridge is composed, and in basalts, which form the rocky banks of the greater part of the river.

c. Bluffs and ice on Goose Bay.

The bluffs on Goose Bay have apparently been entirely neglected by writers although they are continuous with the historic bluff and contain most of the species of fossil mammals found at the latter place. From the base of Elephant Point the bluff rises, southward, to the maximum height of seventy feet and, descending again, forms a bank twenty-five feet high at the first bend of Lost River. It is intersected by several small streams whose valleys are all overgrown and afford no sections; the face, sloping at an average angle of about thirty-five degrees, receives the full benefit of the morning sun and is almost completely covered with grasses and thickets of low willow bushes. The base is slightly cut all along but there are only a few small exposures higher up.

Three glaciers are visible, one of which — located in the steepest and highest part of the bluff about midway between Elephant Point and Lost River — has a remarkable structure (see Figs. 1 and 2). Its entire length is sixty-five feet, and the vertical face has a height of six feet at one end while it tapers out at the other. The high end consists of half-inch layers of pure ice alternating with muck containing considerable plant remains; the layers are grouped into five thick strata and a vertical dike of pure ice, running through the middle of the stratified portion of the glacier, separates the upwardly bent ends of these strata which match on opposite sides of the dike. The latter is about two and a half feet wide in the middle, being slightly narrower below and broader above. Next the end of the stratified portion there is another wedge-shaped mass of pure ice four feet wide at the bottom and five feet across the top. Adjacent to this dike there is a section, averaging four feet in width, formed of nearly *vertical* layers — one half inch thick —

[1] Maddren, p. 62.

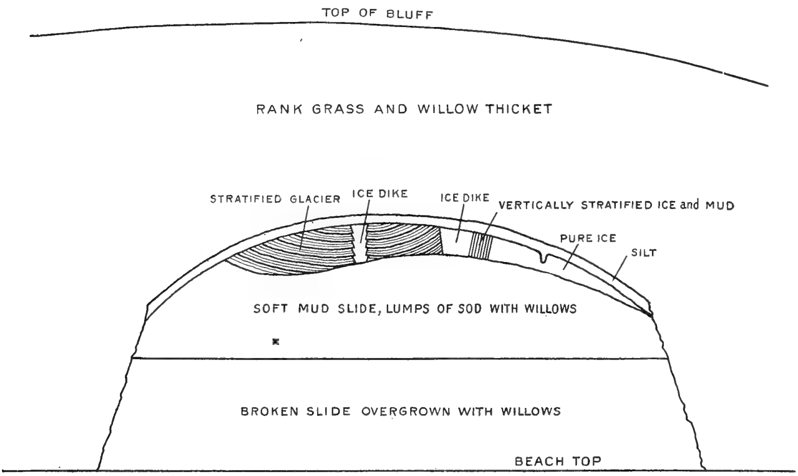

Fig. 1. Stratified glacier in the bluff on Goose Bay near Elephant Point. ×, Mammoth tibia imbedded in block of silt fallen from above the glacier.

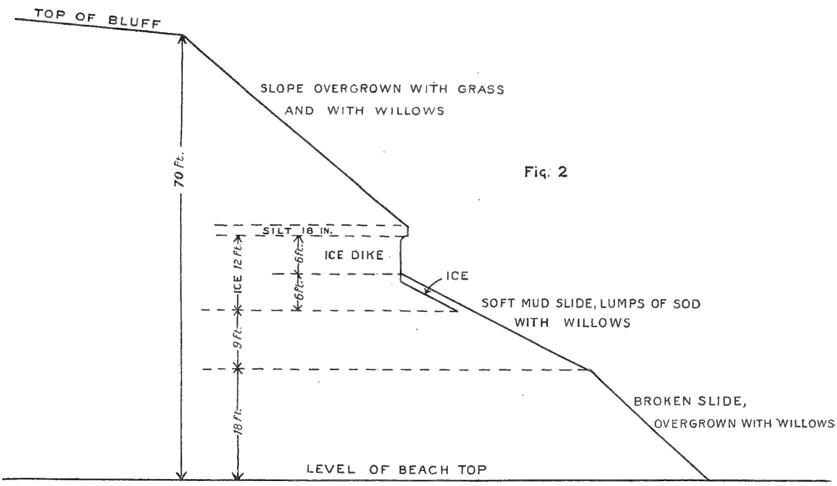

Fig. 2. Section of bluff passing through ice-dike in stratified portion of the glacier.

of pure ice and muck alternately. The remainder of the glacier consists of pure ice, at one point in the top of which there is a small hole filled with the silt which overlies the glacier. Solid ice extends downward below the first described dike and forward under the mud slide adding at least six feet to its total vertical thickness. The silt here seems to have been deposited unconformably upon the top of this curious glacier though slides may have modified the upper contact. The lower contact is concealed. Fossils are certainly contained in the upper part of the bluff for a broken mammoth tibia (×, Fig. 1) was found imbedded in a large block of silt which had overturned in falling from above the glacier to the mud slide below, where it was held together by the roots of a willow bush upon which it rested.

The silt deposit along the west side of Goose Bay extends downward below water level and at one place the soft clay beach — which is covered with only a thin layer of sand — contains a large quantity of small, round quartz pebbles. Five eighths of a mile north of the mouth of Lost River a horizontal seam of black lignite appears in the base of the bluff at high tide level. This 'mine' has been staked but the small prospect holes have caved in and it was impossible to see much of the coal; the layer seemed to be at least two feet thick and a quarter of a mile long, and to be covered with a finer and lighter colored clay than that composing the main thickness of the bluff.

The mammoth tibia above mentioned was the only fossil found on this stretch of the bluffs; remains of the following genera were collected on the beach and broad clay flat which is exposed at low tide: — *Elephas, Equus, Bison, Rangifer, Rangifer* sp. nov., *Ovibos*.

Along the bends in the lower part of Lost River there are several small cut banks and, on the beaches below them, parts of *Elephas* and *Rangifer* were collected.

The bluff is interrupted at the mouth of Lost River by a low marshy plain but rises again to a height of thirty feet and, gradually lowering toward the east, runs out altogether a couple of miles beyond. For one mile from the river mouth its steep face is directly cut by the waves, the remaining portion being protected by a narrow strip of marsh and entirely hidden by vegetation. The material is similar to the rest of the deposit, and no ice was exposed. There is no beach east of Lost River but at low tide a very wide clay flat slopes gradually away from the foot of the cut bank: fossils collected here belong to the genera *Elephas, Equus, Bison, Rangifer,* and *Alce*. Several specimens of horse and bison bones were also found on the face of this bluff.

Some small patches of cut bank are seen around the edge of the broad point lying on the west side of the mouth of Buckland River and a few

fragmentary bones and teeth were collected on the clay flats below them; one badly decayed mammoth tusk lay on the talus below a mold in the bank from which it had recently fallen. The following genera were observed here: — *Elephas, Equus, Bison, Rangifer.*

d. North side of Eschscholtz Bay.

A bluff stretches without a break from Choris Peninsula eastward along the north shore of Eschscholtz Bay and is continued up the Ah-weeng-nuk valley in the form of a terrace. For a distance of seven miles the bluff is being cut by the waves and its structure, beginning at the rocky hill on the base of Choris Peninsula, is as follows: — 1st, yellowish, sandy silt, without trace of stratification, half a mile long, fifty feet high tapering down to eighteen feet; 2nd, flat terrace, eighteen feet high and one and three quarters miles long, composed of fine dark bluish-gray silt containing a few small irregular layers of peat,— this terrace extends across the base of Choris Peninsula and several miles north along the shore of Kotzebue Sound; 3rd, fine light colored sand and silt, stratified, three quarters of a mile long, seventy feet to thirty-five feet high; 4th, fine grayish silt (like that at Elephant Point) four miles long, thirty to forty feet high; 5th, a section one hundred and fifty feet long exposing several alternating strata of sand, coarse gravel, sand-and-fine-gravel, overlaid with a thick deposit of fine, light colored silt; the coarse gravel stratum and some of the others are sharply cross-bedded. From this point east the beach is broad and high and the bluff is almost entirely overgrown with grasses, moss, and low willow bushes. The few bare slopes near the top, and the material brought to the mouths of numerous spermophile burrows, indicate that this part of the bluff, averaging about thirty-five feet high, is formed of a deposit of sand containing many small, round pebbles and overlaid with from five to fifteen feet of yellowish silt. No fossils were found east of the cut sections.

The terraced section of the bluff near Choris Peninsula is vertical and there is a soft clay flat in front of it, the remainder of the steep, cut portions is bordered by a low sandy beach. Some trifling patches of ice which had been formed in fissures near the surface were exposed in the fourth section.

Fossils were collected on the flats and beaches at the bases of all five sections of the cut bluff, and two specimens were found on the talus of the third section. A mass of sticks cut by the teeth of beavers was seen imbedded near the top of the bluff at the western end of the second section.

List of genera: — *Elephas, Equus, Bison, Ovibos, Rangifer, Canis* (Eskimo dog?), and *Castor* (dam).

VIII. Fossil Remains found imbedded in the Historic Bluff.

a. Part of mammoth skeleton with some skin and hair.

On the face of hill 2, one hundred yards from the western end, there is a small knoll (see Figs. 3 and 4) which was cut clean and nearly vertically on one side by a fresh muddy slide extending down to the beach; with the exception of this slide and the one below a large glacier exposed nearby, but at a higher level, the face of the bluff at this place is thickly overgrown with grass. The distal end of a mammoth femur projected from a little loose material near the foot of the cut knoll and a perfect tibia lay on the mud slide a few yards below. Pieces of soft flesh and tendon adhered to the femur when it was drawn out of the thawed ground and it was subsequently found upon digging into the knoll that part of a mammoth skeleton (M, Plate XIX, Figs. 1, 2, and 3) was imbedded here in its primary position of entombment. The femur was broken near the head but the proximal end was held in its socket in the innominate bone by tendons and flesh; the distal end, and the fibula, were found in the loose earth which had begun to move downward.

A cut was first made into the face of the knoll in order to get an idea of the position of the skeleton and a clear vertical section of the deposit in which it lay; horizontal layers of the frozen silt were then removed successively from the top of the knoll downward, the result of the excavation being a rectangular shelf cut into the bluff and bounded on two sides by vertical walls at right angles to one another thus exposing two more sections of the deposit. The skeleton unfortunately proved to be incomplete and only the following parts were found: — the right innominate bone, femur, tibia and fibula; four of the small foot bones; lower jaw with the teeth; two tusks; a quantity of small fragments of the skull; six thoracic vertebræ; several caudal vertebræ, and the end of the tail encased in skin and hair; several broken ribs; and a small quantity of flesh, skin, hair and wool. These remains were crowded together in an area about ten by seven feet alongside the cut face of the knoll, and the missing parts of the skeleton were no doubt imbedded in that portion of the hillock which has been carried away by the slide.

The bluff at this point is about eighty feet in height. A layer of gravel two feet thick is exposed at an elevation of twenty-eight feet above high water mark and can be traced along the face of the bluff through the base of the knoll and for some distance on either side of it. The sections showed that the surface of this stratum slopes up at a small angle as it is followed inward at right angles to the face of the bluff (Figs. 3 and 4). The gravel

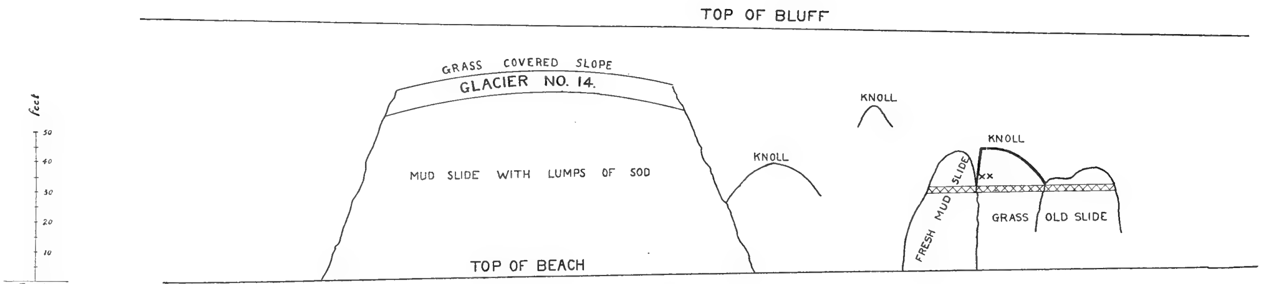

Fig 3

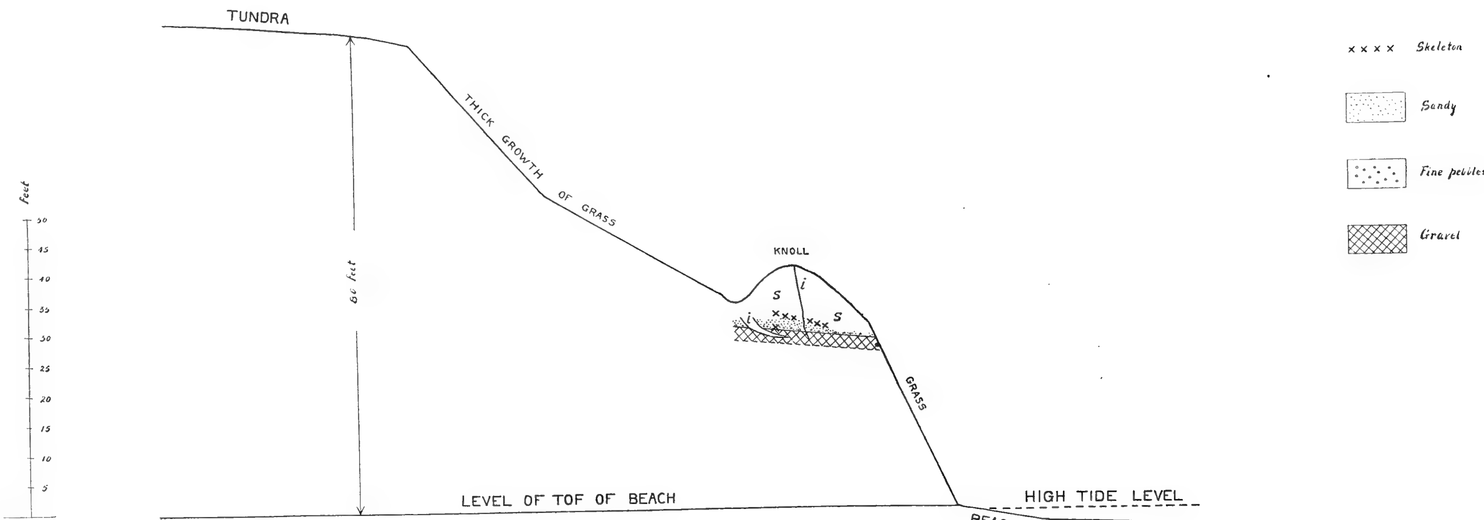

Fig. 4

Fig. 3. Diagram of face of bluff in vicinity of mammoth skeleton (× ×).
Fig. 4. Section of bluff through mammoth skeleton.

consists of small fragments of andesite-porphyry which are only slightly rounded and water-worn, and the interstices are filled with a coarse red sand. Directly below the knoll the section could not be seen but it will be recalled that angular blocks of the above-mentioned rock are falling out of the base of the bluff a short distance away, and that the banks of the stream just west of the knoll exhibit smaller angular fragments of the same material thickly imbedded in coarse reddish sand, and also in silt, at a level slightly above the present beach. Silt is exposed below the gravel in the old slide (see Fig. 3) close to the knoll. The sloping surface of the gravel stratum is sharply marked off from the deposit above it which consists, first, of sand containing some fine gravel; grading into a mixture of sand and silt with an occasional small round or angular pebble; and lastly into a very fine gray silt, or clay, in which are a number of small thin lenses of coarse reddish sand. Irregular lines of stratification dipping slightly to the southwest were shown in the sections above the skeleton. The upper part of the bluff probably consists entirely of fine silt.

The bones were imbedded in a sloping plane, at an average height of two feet above the gravel, partly in the base of the fine silt and partly in the top of the mixture of silt and sand which was somewhat elevated under the middle of the skeleton; but one tusk had sunk down until its convex surface rested on the gravel, while the other lay horizontally in the silt three feet above it. The lower jaw, vertebræ and ribs, innominate bone, and limb bones followed, in this order, down the slope (Fig. 4). The largest piece of the skull was imbedded close to the higher tusk while many small skull-fragments were scattered from this point through the knoll above the skeleton and even beyond the limb bones; this proves conclusively that the animal could not have been bogged, moreover the lenses of sand in the silt above the skeleton showed no traces of the disturbance which would have been caused by an animal sinking through them. It might of course be assumed that after being bogged the skeleton had been uncovered and then re-covered, but in this case one would hardly expect to find any traces of flesh, skin, or hair.

Small pieces of skin with black or brown hair attached, and wads of long black hair, were scattered among the bones. Shreds of tendon still adhered to the ribs and vertebræ. The innominate bone had fallen so as to rest upon its posterior surface and preserved *beneath* it some flesh and a large sheet of skin from the buttocks; there was also considerable flesh about the head of the femur and its socket. Some pieces of skin with long hair were found partly surrounding the femur. The caudal vertebræ and end of the tail encased in skin were imbedded close to the innominate bone; the tip of the tail bore a thick tuft of long black hair as well as a thin covering of

reddish underwool. The wool and hair had rotted out of the skin under the innominate bone and could only be handled in very small sheets. The covering of the mammoth, then, consited of a soft reddish underwool about $1\frac{1}{2}$ inches long and two kinds of hair,— one coarse, wiry, black, as much as 18 inches in length; the other brownish, much finer, and 6 or 8 inches in length.

Small sticks [1] and twigs and rounded lumps of dark brown peat containing leaves, grasses, and rootlets were found among the bones, and beneath the skeleton there was a considerable quantity of bunches of grass some of the stalks of which were slightly green. Some scattered tufts of moss [2] were found in the silt a few feet above the bones. Blackened willow leaves were taken out of the frozen silt both above and below the skeleton, a few small twigs were found above it, and as the vertical walls of the excavation gradually thawed many fine grass stems and rootlets hung out but these were soft and rotten and could not be preserved. A small, thin sheet of chewed grass cut out of the frozen sandy silt close to the lower jaw was as brilliantly green as on the day it grew.

The mammalian remains found in excavating the mammoth skeleton were: a fragment of a caribou tibia; some fragments of a wolf skull with three teeth; one phalanx of a horse; and four small oval droppings.

It is very probable that this mammoth died — or was stranded in the flesh by high water — on a sloping muddy shore near the edge of a sluggish river which had only a short time before swung away from its beach of gravel, derived from the neighboring ridge, and already commenced to cover the stones with fine sediment; that this shore or a meadow just above it was overgrown with grasses — on which the animals fed — and willow bushes; and that as the carcase lay and rotted with the head pointing up the slope the posterior parts first became buried while the skull disintegrated and its fragments were washed down above the rest of the skeleton to be covered later. The irregular, inclined bedding of the silt above the remains, though not conspicuous, the direction of dip *toward* the neighboring hills, and the interstratified lenses of sand tend to prove that this is a flood-plain deposit rather than a lacustrine formation as indicated on Maddren's [3] map; and the presence in the bluff of a beaver dam and tree about on a level with the mammoth add to the probability of the conclusion which applies at least to a portion of the thickness of the deposit. The latter might, however, be assumed to consist mainly of a temporarily drained lacustrine sedi-

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[1] A spruce, *Picea*.

[2] *Dicranum elongatum* Schleich., identical with the form now living in arctic America, or at high altitudes as far south as the mountains of New England.

[3] Maddren, Plate III, p. 26.

Fig. 1. Part of historic bluff, looking west. ×. Position of mammoth skeleton with hair.

Fig. 2. Bluff and mammoth excavation, as seen from the clay flat at low tide.

Fig. 1. Mammoth excavation, looking west.

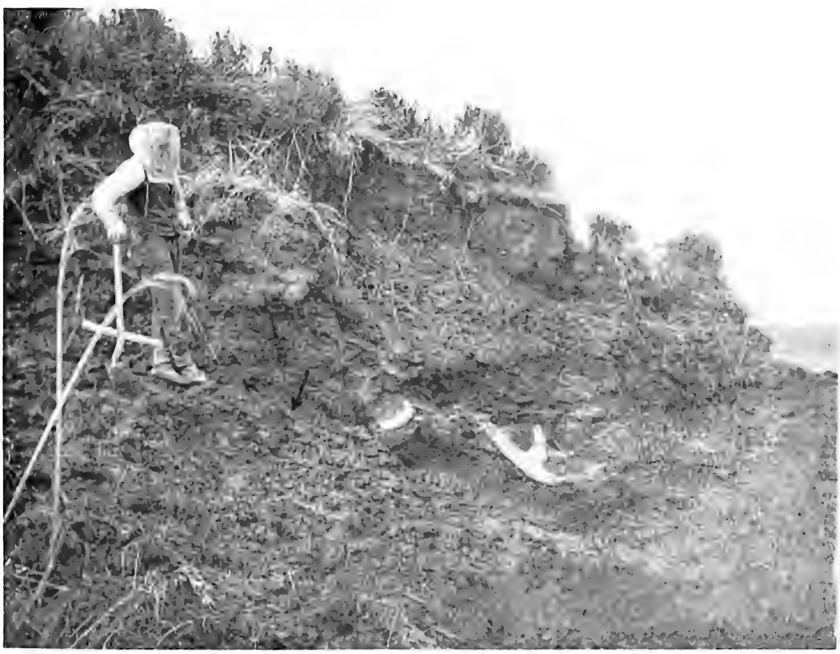
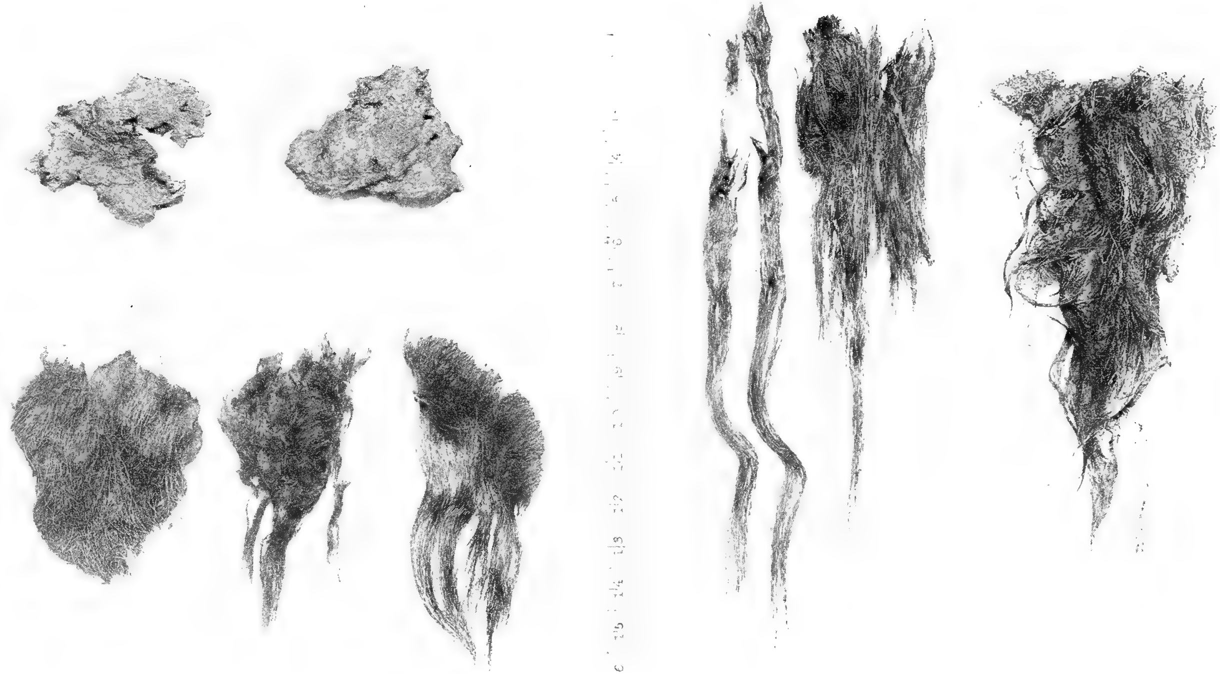


Fig. 2. Tusk, jaw, and innominate bone of mammoth in situ. Arrow points to tip of tusk.



Hair and pieces of skin found with mammoth skeleton.

ment, but its location at a point which can not have been far from the mouth of the Pleistocene river, and the apparent lack of any barrier which could have retained a body of water in this position, seem to negative the lacustrine theory altogether.

b. Beaver dam.

A beaver dam, discovered by a member[1] of Captain Hooper's party in 1881, is imbedded in hill 1 (Plate XIX, Figs. 1, 2, and 3) at a point where the bluff is now vertical and the section clean. It is constructed of sticks[2]

Fig. 5

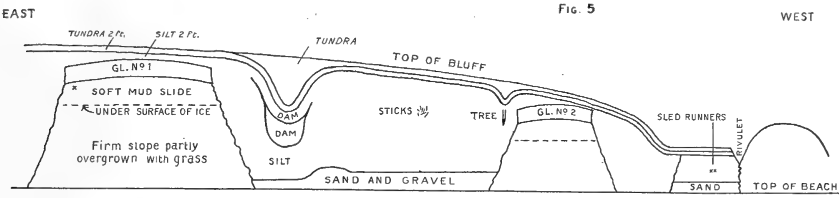


Fig 6

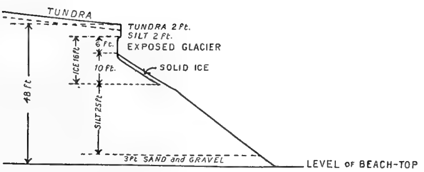


Fig. 7

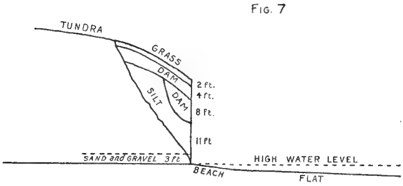


Fig. 5. Diagram of face of bluff, showing beaver dam, etc. × Bison phalanx found at base of glacier No. 1.

Fig. 6. Section of bluff through glacier No. 1.

Fig. 7. Section of bluff through beaver dam.

two or three inches in diameter and from six inches to four feet long all of which show plainly the marks of beaver teeth. The bluff on either side of the dam slopes steeply back from the beach leaving a projecting point preserved on account of the rigidity afforded by the imbedded mass of sticks. The dam (Figs. 5 and 7; and Plate XX, Fig. 1) is about twelve feet thick measured vertically on the face of the bluff, and lies two feet below the surface; it is surrounded by silt, eleven feet thick below the dam, and the base of the section is formed of a three foot stratum of sand and fine gravel.

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[1] See Maddren, p. 112. (Nelson's diagram and description).

[2] Two beaver-marked sticks from this dam have been identified as belonging to the genus *Salix* (willow).

A side view shows that the dam is continued back under the curved surface of the point in which it is imbedded and that the rear end is thinner and several feet higher than the end overhanging the beach, where it is built in two layers.

In 1907 a small glacier was exposed on each side of the dam, one being a trifle higher and the other somewhat lower than the level of the rear end — but both extending down, as shown in Figs. 5 and 6, several feet below the base of the exposure — making it appear as if we had here sections of the frozen stream itself. This seemed the more probable since it might readily be imagined that the ice connecting these glaciers and passing through the dam had melted away allowing the latter to sink at the forward end, and it is difficult to give any other explanation of the drooping position assumed by the dam for no trace of cracks or displacement were observed anywhere above or around it. As if to confirm the supposition the forked trunk of a tree[1] six inches in diameter was found imbedded vertically in the bluff close to the end of one of the glaciers (TREE, Fig. 5) suggesting that it had grown on the bank of the stream. Half way between the dam and tree a few scattered beaver sticks were weathering out of the bluff. The tree stump was traced by digging down into the frozen silt and its spreading roots followed for three or four feet; bark[2] surrounded the stem below the line of frost and, from all appearances, the tree had grown *in situ*.

According to Nelson's description the relations of ice to the dam were the same in 1881 as when the writer first saw it, although in his diagram the 'nest' is shown imbedded in a layer of ice. The glaciers were only two or three feet thick (horizontally) in 1907 for in the following season they had entirely disappeared and, as stated above, vertical, frozen walls of silt remained in their places; but, if the two ice-layers which Nelson described were continuations of the glaciers shown in Fig. 5, it is plain that during the interval of twenty-six years, melting must have removed many feet and the ice must have originally been too extensive (horizontally) to be accounted for by the freezing of water in vertical fissures. The evidence here seems to point more toward than against the theory of interstratification of the ice for the glaciers were overlaid with the same silt in which they were imbedded, and a bison phalanx (×, Fig. 5), found on the mud slide close to the base of glacier no. 1, undoubtedly fell from the silt above (unless we assume that it was contained within the glacier itself — and there is no record of such an occurrence). The beaver dam is positive proof of the existence, on the *surface*, of a small stream of running water such as one

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[1] Identified from sections as a *Salix*, or willow.

[2] The bark was more heavily coated with a brilliant blue powder (phosphate of iron?) than any of the fossil bones.

might expect to find, together with trees and other vegetation, on a river flood-plain or drained lake bottom, but if there is any connection at all between the beaver dam and ice it is more reasonable to assume that the latter was interstratified, along with the dam, on a flood-plain rather than covered with sediment at the bottom of a lake.

It may be of interest to mention that a pair of primitive wooden sled runners hewn from solid logs were found projecting from the vertical bluff by the side of a rivulet near the beaver dam (sled runners, Fig. 5). This rivulet falls to the beach from a channel in one side of a small, flat-bottomed, marshy valley which has been eroded down to the layer of sand showing in section just above the beach and re-filled with a dark, brownish 'muck' containing many small (alder?) sticks imbedded at every angle. The floor of the valley is fifteen feet above the beach, and the runners were lying horizontally in the frozen muck seven feet below the surface, but although their age must be great they probably belong to the Recent period and can not be considered contemporaneous with the Pleistocene fossils.

c. Other fossils.

The caribou, wolf, and horse bones, and small droppings found imbedded along with the mammoth skeleton have been mentioned above; to these must be added a few other specimens, the most important being some parts of another mammoth skeleton. The scapula, broken into several pieces, was found lying horizontally six inches above the middle of glacier no. 4, in the overhanging wall of silt, at an altitude of forty-six and one half feet above the beach (1, Plate XIX, Fig. 3; and a, Figs. 8 and 9). Some small sticks were imbedded with it. The broken humerus (c, Fig. 8) lay close to the base of the glacier where it had just fallen and two carpals (d and e, Figs. 8 and 9) were found on the slide some distance below. After an interval of three weeks, during which the glacier had melted back and become partly covered by material from above, a tooth (f) was found on the fresh talus almost touching the ice, but nothing more was revealed by digging. It seems safe, however, to conclude that these are associated bones belonging to a skeleton which had been imbedded here in its original place of deposition.

At the point marked 2 (Plate XIX, Fig. 3) the tip of an almost complete caribou antler protruded from the bluff at a height of one hundred and eight feet above the water. Within a few feet of it a horse phalanx and two sesamoids were dug out of the silt, another phalanx having been found on the surface; these four bones belong together.

Two more bones of the horse may possibly be associated. An astragalus was found imbedded close to the top of the bluff (3, Plate XIX, Fig. 3) a

little to one side of a vertical line passing through the mammoth skeleton (M), and a phalanx lay on the surface a few feet below it.

This completes the list of fossils seen actually imbedded in the bluff, but mammoth, bison, horse, and caribou bones were found in the stream

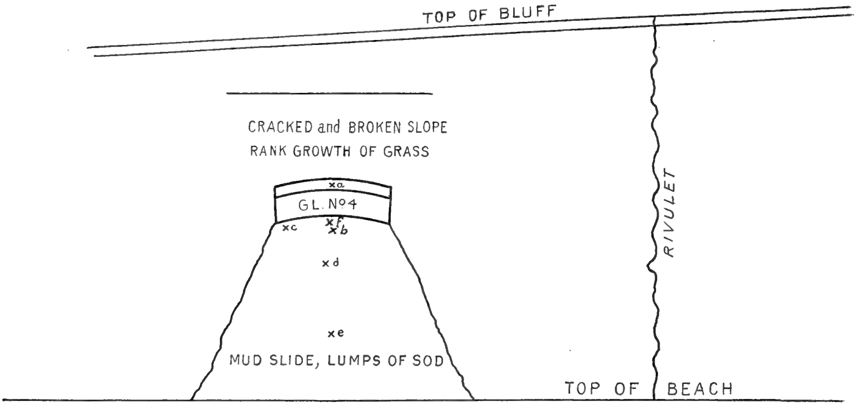

Fig. 8

Fig. 8. Diagram of face of bluff at glacier No. 4, showing position of imbedded mammoth scapula and other bones on the surface.
a. Scapula. b. Large fragment of scapula. c. Broken humerus. d. Carpal. e. Carpal. f. Tooth.

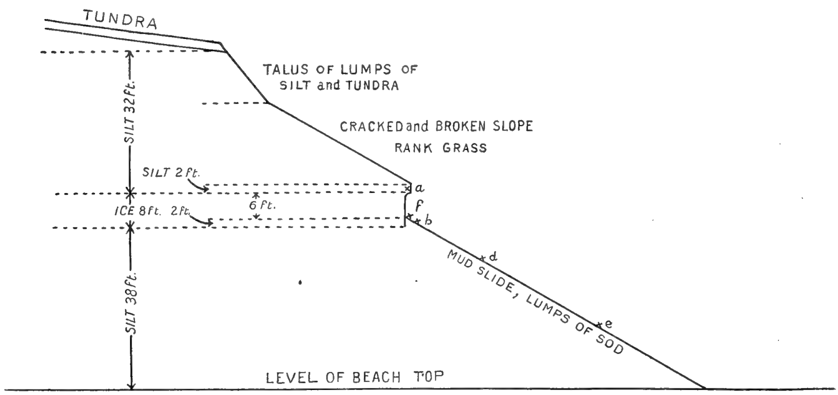

Fig 9

Fig. 9. Section of bluff through mammoth scapula. Lettering as in Fig. 8.

between hills 2 and 3 (Plate XIX, Figs. 1, 2, and 3) far above the reach of any tide or storm, and bones of the same genera were gathered on the face of the bluff at various heights.

IX. Remarks on the occurrence of Fossils and Recent Bones on the shores of Eschscholtz Bay.

There are only two or three references to fossils found in or upon the historic bluff. The preceding section has demonstrated that the deposit at Elephant Point contains remains of the beaver, mammoth, horse, bison, wolf, and caribou, but most of the fossils around Eschscholtz Bay are found in a narrow zone along the edge of the clay flats below the sloping beaches, where the latter exist, and this fact has given rise to the statement that the bones have not been derived from the bluffs but were transported by ice from Buckland River. Nevertheless the writer believes they have all fallen from the beds of silt close to where they lie and that their position on the flats is obviously to be explained as follows: — as the face of the bluff is eroded away thawing proceeds gradually inwards to a depth of two or three feet and the surface layer of wet and more or less muddy clay slides or flows downhill over the still solidly frozen interior. At the limit of frost the bones fall one by one into the loose covering and are often broken by the shearing stress in this plane. Since the surface material seldom holds together in solid blocks — excepting lumps of the superficial sod — and consequently does not roll downhill, the fossils remain underneath the surface and first appear when they slide out onto the top of the beach. In this manner the parts of an associated skeleton become separated. They are then washed by the waves, at high tide, down the sloping beach, as was observed in the case of two large mammoth teeth, and carried out a few yards on the flat where they become partly or wholly buried in the clay. In other words only the small proportion of fossils which drop out of cut surfaces above glaciers and on the sides of knolls, etc., are seen on the face of the bluff. Several specimens, which could not have been originally overlooked, were found on beaches after intervals during which we had been to other parts of the bay,— for instance, a musk-ox cranium appeared at the base of a fresh slide near Elephant Point some time between August 28th and September 16th, 1907. There is no evidence of transportation by ice for not a single fossil was found, anywhere about the shores of Eschscholtz Bay, opposite an uncut bank, nor were any of the river rocks seen on the beaches or flats.

Fossils found on the bluffs, and sometimes those on the beaches, are light-brown in color and generally coated with a bright blue powder, phosphate of iron,[1] but this powder easily rubs off and does not remain on bones which have been exposed on the flats to washing by waves; the latter are mostly very dark, in fact almost black when wet, but some are still light

[1] Sir John Richardson (Maddren, p. 23). See also Gilmore, p. 29.

colored and these have evidently not been long in the water. The jaw and some antler fragments of a moose, found near the mouth of Lost River, were all thickly coated with the blue powder which may be taken to prove that they had recently fallen from the bluff. Musk-ox and moose do not range at present in the territory drained by waters flowing into Eschscholtz Bay and there can be hardly any doubt that remains of both of these mammals, found in this locality, had been imbedded in the Pleistocene deposits.

The shores of Eschscholtz Bay have formerly been much frequented by Eskimos for numerous signs of old igloos and camps are seen in every favorable situation, and quantities of bones of the beluga, whose meat is highly esteemed by the natives, are strewn about them together with some remains of caribou. The latter animals are found living to-day on the headwaters of Buckland River and they are also occasionally seen throughout the northern slope of Seward Peninsula; it is said that they do not occur on Eschscholtz Bay, but large numbers of domesticated reindeer are herded here, on the north side, every summer. The caribou and beluga bones have become of a light to dark-brown color (but never blue) indistinguishable from that of the fossils and it is therefore impossible to separate them by superficial appearances. Large bears also inhabit the Buckland River region and wolves sometimes appear on Selawik River, just across the divide, hence doubt may remain as to the age of some of the scattered bones of certain extant genera. The living animals whose remains one may expect to find mixed with the scattered fossils are, besides marine species: — bear, wolf, Eskimo dogs, caribou, domesticated reindeer, and smaller mammals.

X. Ah-weeng-nuk River.

The bluff on the north side of Eschscholtz Bay is continued for at least twenty-five miles up the Ah-weeng-nuk valley (see Map I, Plate XVIII), the deposit forming a terrace between the river and a ridge of hills. In spite of many winding curves this small stream flows very swiftly over a gravelly bed, and high gravel bars have been piled up in the bends; it enters the bay by two mouths — one of which is very narrow — flowing across a broad, low, delta sprinkled with many small pools. Old ox-bow channels show that the stream has moved toward the north although at the present time it rarely cuts the terrace. The banks are lined with willows sometimes as much as five inches in diameter and ten feet high; on the bluff are a few small cottonwoods and birch trees besides thickets of willows, alders, and other low shrubs.

Eight miles above its mouth the river flows away from the terrace which is here about seventy feet in height; some bare slides are exposed near this

point and the deposit is seen to consist of sand, containing quantities of small round pebbles, with a six-foot layer of silt lying on the top. Twenty miles up the river there is a short stretch of cut bank (Fig. 10) fifty feet high, the section being as follows: — tundra 2 ft.; silt 20 ft.; thin strata of sand containing gravel, and some thin layers of pure sand, altogether 8 ft.; the lower part is concealed by loose sand. A mammoth phalanx was collected on this talus, and two waterworn, fragmentary, mammoth limb bones were found on gravel bars a few miles downstream but no other fossils were seen

Fig. 10. Cut bank, twenty miles up the Ah-weeng-nuk River.

on the river. A small glacier, formed of alternate layers of ice and muck, is exposed in the top of the cut bank just under the tundra. A couple of miles above, the river flows around a projecting point of lava; the terrace then begins again and extends some distance upstream but it appeared to be entirely overgrown and was not followed further. Exposures of sand and fine gravel are also to be seen on the south side of the valley along a small brook which enters Eschscholtz Bay at the very mouth of Buckland River; no fossils were found here.

XI. Buckland River.

Before the opening of a road from Candle freight was towed in small barges about forty-one miles up the Buckland River to the mouth of West Fork, which flows in from the south, and up this stream to Bear Creek where some gold placers are located. The main river has also been examined by prospectors who asserted that it is navigable for two hundred miles and that numerous fossils are found along its banks.[1] Maddren indicates here an area of elevated, Pleistocene, lacustrine silt and Pleistocene mammal deposit.[2] In view of these facts, and the possibility that some of the fossils at Elephant Point had been derived from deposits on the Buckland, it seemed desirable to explore the river and a light canoe was shipped to Keewalik for this purpose. The water was so low on account of the dry spring season (1908) that we were obliged to do a great deal of wading, and to make many otherwise unnecessary portages over shallow gravel bars; and canoeing had finally to be abandoned at a point estimated at eighty-six miles above the river-mouth. We walked several miles further but, since few good fossils had been seen and as the river was constantly falling and seemed about to dry up altogether, we turned back.

The Buckland River is probably not over one hundred and fifty miles in length from extreme headwaters to mouth. The north and middle forks come together from the northeast and southeast, respectively, about eighty-nine miles, by river, above Eschscholtz Bay; these streams are of equal size and each is no doubt navigable for a few miles by canoe in a season of average rainfall. The foothills of a low mountain range, the Koyukuk-Buckland watershed, extend to within eight or ten miles of the forks, below which the river flows through low rolling hills of lava as far as the head of tidewater, twenty-two miles above Eschscholtz Bay. At this point a bar of lava boulders stretches across the stream forming at low tide an unnavigable cascade which at high water is hardly noticeable. One mile up North Fork the lava overlaps older, stratified, sedimentary rocks exposed in the bed of the stream and in two high hills alongside of it.

For the first twenty-two miles the river flows in a wide valley whose floor is covered with sediments. A sandy bank forty feet high begins at the mouth of Duck River and extends one quarter of a mile downstream; a bear and two bison bones were collected here. A bison vertebra was found on the face of another high, sandy bank one mile below. A third bank,

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[1] See also Moffit, p. 42.

[2] Maddren, Map, plate iii.

composed of coarse sand, is exposed on the same side of the river about three miles above the mouth, but there was no evidence that it contained fossils. Mammoth, bison, horse, and caribou bones were collected along a fourth bank (Plate XXIV, Fig. 1), also on the left side of the river, some of the fossils having been found in the bluff itself and others on the beach below it at low tide. The river is rapidly cutting into this bank which extends for nearly two miles around a bend and varies from ten to forty feet in height; the deposit — beginning half a mile from Eschscholtz Bay and proceeding up the river — changes abruptly from one material to another, as follows: — 1st, stratified sand; 2nd, alternate half-inch layers of moss [1] and fine clay; 3rd, muck and peat; 4th, the upstream half of the bank consists mainly of fine silt but some parts are sandy and show traces of stratification; most of the fossils were found along this section. The entire exposure seems to be a section of an elevated delta which contains channels or ponds filled with deposits some of which may be Recent. Just below the bar at the head of tidewater there is a short bank, thirty feet high, of fine light colored silt exposed in a bend where a few fragments of bison and other bones were found.

From the tidewater cascade to the mouth of West Fork the river runs in a narrow, crooked, valley eroded down into lava and frequently cuts the hills, forming vertical cliffs from fifty to seventy-five feet high. West Fork runs swiftly from side to side of a broad, sparsely-timbered valley and enters the Buckland at the lower end of an open basin about five miles in length. At the head of this basin the main river flows out of a winding valley about six miles long and so narrow that it may properly be called a canyon; the walls are in many places vertical and, just above the middle of the canyon, show the columnar structure of the lava very clearly. Half a mile below this point a ridge and some large boulders of lava form an obstruction in the river, which makes it necessary to portage for two hundred yards. The valley widens out again at the head of the canyon to form a long basin extending above the forks to the foothills of the Buckland-Koyukuk divide; the river meanders down in a very tortuous channel — occasionally winding to the hills where it cuts cliffs in the lava — but nevertheless flows swiftly over many shallow riffles between the deeper holes. The valley is timbered at the forks with large groves of fir trees thirty or forty feet high. Numerous ponds and a few old river-channels are seen on the flat surface of the deposits

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[1] This part of the bank is about ten feet high; the moss in the lower layers is *Drepanocladus fluitans* (Dill.) Warnst. and that of the upper plant layers *D. scorpioides* (L.) Warnst. They are identical with species widely distributed at the present time in northern countries, or at high altitudes, and forming dense growths in stagnant water. Some broken shells of small lamellibranchs and gastropods were also taken from this bank, but the specimens have been lost.

which cover the bottom of the basin. The cut banks, averaging perhaps ten feet high, expose sections of gravels, sands, and alluvium, often irregularly stratified, or unstratified deposits of fine grayish silt.

A large loop of the river is cutting into a thick sedimentary deposit which remains hanging to one side of the basin, near the lower end, and a steep bluff is formed about one hundred feet in height; the silt of which it is composed is without trace of bedding but it rests upon four feet of faintly stratified sand and gravel. The material is coarser than that at Elephant Point and slightly different in color. Minute fragments of plants are contained in a sample but no sticks were found in the bank. Several broad, wedge-shaped 'glaciers' are exposed in the upper part of the bluff but they are imbedded in the silt and certainly do not lie upon the top of the deposit — as described [1] in the case of the Old Crow River ice-beds — nor do they appear to be parts of a continuous layer of ice. Smaller silt deposits are seen against the sides of the narrow valley in several places along the river below the canyon.

The high bluff is being cut for the distance of one quarter of a mile, but a careful search resulted only in the find of a horse calcaneum and a small unrecognizable fragment of bone, both of which might have been brought from higher up the river; the shallow water at the base of the bluff contained no fossils and this deposit seems to be barren. On the other hand a number of fragmentary fossils were found at the lower silt banks in this basin and along the river below the canyon, and a few decayed mammoth tusks and bones were seen at various places in the river-bed. One well-preserved tusk (Plate XXIV, Fig. 2), lacking the tip, lay on the talus of a low silt bank at the middle of the upper basin, but the evidence goes to show that reports are much exaggerated, that the Buckland River is an unpromising locality, and that there is little likelihood of finding important deposits cut by any of its branches. The best specimens were found at the banks near the mouth of the river.

Bones, or fragments, of the following genera were noted: — *Elephas*, *Equus*, *Bison*, *Rangifer*, *Ovibos*, *Alce*, *Ursus*, *Canis* (wolf).

XII. Hotham Inlet and Selawik Lake.

Hotham Inlet is an arm of non-tidal fresh water separated from Kotzebue Sound on the west and Eschscholtz Bay on the south by a long narrow peninsula consisting of sediments elevated to a height of over one hundred feet above sea level. The low Kobuk delta occupies its inner angle while

[1] Maddren, p. 15.

Fig. 1. Cut bank on Buckland River, near the mouth.

Fig. 2. Mammoth tusk and low silt bank in upper basin of Buckland River.

high bluffs extend all around the outer curve and along the southern side of Selawik Lake.

The bluff is cut in a few places on Selawik Lake for a distance of fifteen miles from the outlet but it appeared to be entirely overgrown with vegetation to the east and was not examined further. The deposit is mostly unstratified sand containing considerable gravel; in some parts silt lies on the top, in others the bluff is composed entirely of silt. A few small fragments of mammoth tusks and caribou bones were found on the gravelly beach but no fossils were seen on the bluffs.

On the south side of Hotham Inlet there are some cut bluffs, one hundred feet in height, composed of silts but containing near the top an ill defined stratum of waterworn gravel and boulders, up to six feet in diameter, which are imbedded in the fine sediment and must have been deposited by floating ice. The gravel consists of quartz, conglomerates, and gneissoid rocks and shows no signs of glaciation; one rounded lump of black, bituminous coal was collected on the talus. In the southwestern angle of the inlet a vertical section shows that this portion of the bluff is sharply divided into very thin horizontal strata, from top to bottom. A steep, continuous bluff of yellowish silt extends along the west side of Hotham Inlet for at least fifteen miles to the north; it varies from fifty to one hundred feet in height and occasionally shows some traces of stratification. Several pieces of mammoth tusks and some small unrecognizable fragments of bone were found on the gravel beaches or in the water along Hotham Inlet, but only one specimen — the metatarsal of a horse — can be definitely stated to have come from these barren deposits; it was found on the talus on the west side of the inlet about on the latitude of the Arctic Circle.

XIII. Summary and Conclusions. List of Pleistocene mammals of Alaska and adjacent Canadian Territory.

The Pleistocene deposits of Alaska and the Klondike region have been divided into dark mucks [1] accumulated in gulches and on the smaller streams, and light-colored silts and sands, frequently with underlying gravels, appearing along the sides of the valleys and in the basins of the river courses. The latest investigator [2] concluded that the former deposits have hitherto

[1] The term 'muck' is rather indefinite though it may usually be taken to mean a dark brownish mixture of sediment and decayed vegetable matter of the nature of a bog or swamp. McConnell (p. 35) says that mucks in the Klondike district are usually massive but sometimes interbanded with layers of sand. Mucks frequently contain sticks (see Gilmore, p. 16), and even large logs have been found in them (Collier (1), p. 27). Trunks and cones of fir trees are said to be found in the base of mucks on Inmachuck River about ten miles above Deering, and at other places on Seward Peninsula.

[2] Gilmore, pp. 25, 26.

furnished the best preserved mammal remains, and that they are the most promising collecting grounds while the silts and sands contain mainly scattered and fragmentary parts. The writer's observations also show that thick beds of *structureless* silts and fine sands both in the interior and on the Arctic coast are either barren or supply only a few isolated bones and water-worn fragments; sticks in their natural condition are likewise rare in these deposits which, however, occasionally contain layers of lignite. The underlying gravels, when present, often appear to be contemporaneous,[1] as, for instance, at the high silt bluff in the upper basin of Buckland River, but no fossils have been recorded from them. The bluffs on Selawik Lake, most of the north side of Eschscholtz Bay, and in the Ah-weeng-nuk valley, all consisting mainly of sand containing pebbles but in some places seen to be overlaid with silt, are as barren as other gravels, in so far as could be determined. In general the probability of finding bones associated or in good condition increases with the fineness of the sediments, but certain banks on Eschscholtz Bay and the lower Buckland consisting of light-colored more or less sandy material *showing stratification* also hold bones in good condition although in these cases there is no evidence of association.

That the mucks of small valleys and gulches in various parts of Alaska and the Klondike region contain many well-preserved mammal remains has already been shown, and can be fully confirmed by the writer, but the Elephant Point deposit, formed in an entirely different situation, is at least equally productive and has supplied the best cases known of fossils in primary positions of entombment in the regions under consideration. It is therefore not at all certain that these mucks are the most promising fossil beds, and it may be recalled in this connection, if it is allowable to compare with Siberia, that the best preserved remains yet discovered — namely, the Beresowka and Lena mammoths — were found in open places on large rivers. The writer believes that at least that portion of the Elephant Point beds which contained the mammoth skeleton with hair, etc., is a river flood-plain deposit. There is some doubt as to the exact horizon and nature of the deposits in which the Siberian mammoths were originally imbedded, but there seems to be no more reason for considering them lacustrine than flood-plain sediments; and either kind of formation might have been covered[2] at certain times and places with fossil-bearing bogs, which need not be supposed to have been confined to small valleys either in Siberia or Alaska.

The Elephant Point deposit, like the mucks, contains a considerable

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[1] Maddren, pp. 27, 28.

[2] Gilmore (p. 21) gives a diagram of a basin filled with "alluvium and mucky material" resting on silt at the Palisades on the Yukon River. In this case while fossils were found in the silt it does not appear that any were seen in the overlying muck.

quantity of leaves, grasses, twigs, and sticks some of which are waterworn, but there is a very important distinction between the two: the former is stratified, at least in part, and fossils were found actually imbedded at various heights from the thirty foot level to the top; whereas there seems to be no doubt that whatever may be the depth and location of the mucks, fossils are here always found within a few inches [1] of the underlying gravels or broken bedrocks, or resting upon and sometimes partly imbedded in the substratum.[2] From this Gilmore naturally concluded that the animals were mired in bogs and sank to the bottom before the latter became solidly frozen, and he says: "If mired down in such a place, why is it that the remains should be so universally scattered?"

It seems to the writer that the remains may not be so scattered either in the mucks or certain of the fine-silt deposits as is generally supposed. Most of the mining in Alaska and the Klondike region in Canada is carried on in the smaller valleys and gulches where thick accumulations of muck must be removed in order to get at the gold in underlying gravels; this is accomplished by leading streams over the frozen mud or by means of powerful hydraulic jets directed against it, and neither method is designed for careful exhumation of complete skeletons. Considering the rough treatment by hydraulic power, many bones, found mixed with coarse gravel on the tailings of the Fox Gulch mine, were in remarkably good condition. The fine state of preservation of several bison skulls — one specimen retaining the outer horn sheaths — which had been removed from muck at the head of the gulch can leave little doubt that this is a place of primary entombment and that careful excavation would lead to the finding of associated material. Two cases, mentioned below, are known where associated bones were taken out of deep mucks in widely separated localities by the more gentle method of thawing prospecting shafts by steam.

The frozen deposits of Alaska are preserved by their protecting mantle of tundra vegetation and since there is a minimum of lateral erosion on the smaller headwaters it will be seen that the mucks are rarely much exposed except where extensive mining is in progress. The difficulty in finding fossil

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1 See Gilmore, pp. 16, 25.

2 There are a few exceptions to this statement. The writer saw a small mammoth tusk which had been found projecting from the surface of the ground near Imuruk Lake, Seward Peninsula, and heard of similar occurrences in other parts of Alaska. A case of the same kind is recorded by Moffit (p. 41), but in no instance has the material in which the fossils were partly imbedded been determined or examined. Mammalian remains have also been found lying on top of the tundra (see Gilmore, p. 32; Maddren, p. 115 (Townsend); Allen J. A., p. 168, footnote (Dall)). The validity of these latter occurrences seems somewhat doubtful in view of the fact that Eskimos and prospectors frequently collect fossils as 'curios' and transport them for long distances, and that the fossils may have been dropped in the course of travel wherever the load became inconvenient.

remains in frozen river banks is due to a different cause: here lateral erosion produces steep or even overhanging bluffs in the concave sides of bends where deep channels usually swing against the very base of the deposits, and the swift current rapidly removes any recently fallen talus. Fossils therefore drop directly into the rivers or, in the comparatively rare cases where one happens to find a fossil on a fresh slide, there is often such a large quantity of loose material that the remains cannot be traced to their source. At Elephant Point, where the bluff is inclined, the thawed surface layer slides down bodily and separates the hidden bones in a manner already described, but in several cases skeletal parts were found close together and in such positions as to lead to the belief that associated skeletons are not uncommon in this deposit. Collecting in Alaska is a much more difficult matter than bad-land collecting and it seems reasonable to conclude that the conditions alone are responsible for the usual statement that Alaskan fossils are always scattered and in secondary positions. These same conditions together with the muddy state of the surfaces may also account for the fact that no remains of small mammals have yet been seen.

The few authentic records of associated mammal remains found in primary positions of entombment in Alaska and the Klondike region are enumerated below: —

1. Part of a mammoth skeleton, together with some flesh, skin, and hair.
2. Tooth, and some bones of the fore limb, of a mammoth.
3. Two phalanges and two sesamoids of a horse.
4. The beaver dam, discovered by Nelson, may also be mentioned here. These specimens were found by the writer imbedded in the historic bluff near Elephant Point, Eschscholtz Bay, Alaska, and are described above.
5. Mammoth skull with tusks and a quantity of hair and wool. Dug out of the historic bluff at Elephant Point in 1849 (see Maddren, p. 101).
6. "Vertebrae of bovine animals lying in their proper order of sequence." Historic bluff, Elephant Point, 1849 (see Maddren, p. 99).
7. Mammoth bones, fat, and disintegrated muscular tissue. Found in the bank of Naknek River, Alaska Peninsula, in 1894. (Dall, (3) pp. 857, 858; and Dall, (2) pp. 635, 636.) A specimen of the "hard tallow" containing "numerous dried muscular fibres" is preserved in the U. S. National Museum.
8. Portion of a mammoth skeleton. Woodchopper Creek, Alaska. (Gilmore, p. 25). The writer learned that this specimen was found in sinking a thawed shaft deep into the muck in Alice Gulch (tributary to Woodchopper Creek, Yukon River, near Circle) and that the parts secured consist of the skull and lower jaw, with both tusks and all the molars; pelvis; 1 scapular 2 limb bones; 12 vertebræ; 15 ribs; and some small bones.
9. Complete mammoth skull with tusks and teeth; also said to have been surrounded with the bones, which were not preserved. Found 42 ft. below the surface, in the muck on Quartz Creek, near Dawson, Canada. (Gilmore, pp. 5, 6, 25; and pl. VII.) Quartz Creek is tributary to Indian River.

10. Mammoth skull and lower jaw, both nearly complete; tusks and all the molars perfect; 1 femur. Found in the muck on No. 35 Gold Run, branch of Indian River, near Dawson, Canada. On exhibition in Dawson in 1907.

11. Walrus skull complete, with teeth and tusks. The finder stated that the bones of the skeleton were seen close to the skull, but were not collected; he also thought that some of the flesh had been preserved, but this seems rather doubtful. Found about 31 ft. below the surface, in the 'pay sand' of the second beach line (Quaternary), one mile east of Fort Davis, near Nome, Alaska. Skull examined by the writer in Nome in 1907 (see above).

The ice at Elephant Point — in whatever manner and period it may have been formed — is distributed in separate layers or masses throughout the thickness of the deposit and bears no definite stratigraphic relation to the fossil mammals for the latter are also imbedded at different heights from the top down to the thirty foot level, if not to the bottom. While there is doubtless more ice within these beds than can be seen on the face of the bluff the ratio of pure ice to frozen silt is a small fraction, as in all other described exposures in Alaska, and the commonly used term 'ice-cliff' is obviously erroneous. Fossils have never been found imbedded in pure-ice-masses and the term is particularly misleading since it implies that preservation of flesh and hair is due to the ice, whereas this is not the fact in regard to either of the two specimens found at Elephant Point, nor does it appear from descriptions to be true in the cases of the Siberian finds.[1] It seems entirely clear that the flesh, skin, and hair of the mammoth found by the writer were preserved only on account of having been pressed down underneath the larger bones into soft mud, while most of the body remained above the surface of the ground where the soft parts rotted away.

Since there was enough heat for the growth of plants and for exposed flesh to decay, a *sudden* fall of temperature cannot be called upon, as has been frequently done, to account for the extinction of Pleistocene mammals and the preservation of their flesh; moreover they outlived this specimen for associated bones of the mammoth and horse were found in the same bluff at a higher level.

If the sediment above the skeleton represents a flood-plain deposit, as seems most likely, these remains may have frozen soon after burial and continued frozen ever since upon the assumption that the mean annual

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[1] Mr. Adams. Journal du Nord, St. Petersburg, 1807.

Dr. Tilesius. De skeleto Mammonteo Sibirico ad maris glacialis littora anno 1807, effosso, (etc). Memoires de l'Académie Impériale des Sciences de St. Pétersbourg. Printed in St. Petersburg, 1815. Vol. V, p. 406 et seq., plates x and xi. Extracts from Adams' account, p. 445 et. seq.

The essential facts are also quoted by Buckland, see Maddren, pp. 85, 86.

Herz, O. F. Frozen Mammoth in Siberia. Ann. Rep. Smithsonian Inst., 1903, pp. 611–625.

temperature was below 32° F. and that the deposit itself progressively solidified as it was laid down. But, if flesh was preserved only when protected from air, bodies found entire must have been rapidly and completely covered, and it is not evident how this could have occurred otherwise than by their sinking into some kind of soft or boggy ground. The Elephant Point deposit appears to have been too solid for this to have taken place. But that all frozen bogs are not equally promising for the finding of whole carcases in the flesh is shown by the discovery of such a large quantity of well preserved skeletal material, without soft parts, in mucks in small gulches. And associated bones are likely to be found imbedded either in mucks or in fine, more or less stratified sediments of fluviatile origin.

The existence of bogs amounts to a proof that some portions of the surface were thawed to a considerable depth but does not necessarily preclude the possibility of progressive freezing of flood-plain deposits for thawed and frozen grounds exist side by side, and even alternating one above the other, in Alaska to-day, and pure ice is known to occur interstratified [1] in Recent alluviums. Preservation of flesh was no doubt aided by the low temperature of the deposits, but that the Pleistocene climate was somewhat milder [2] than that of the present time seems to be proved by the fact that large trees have been found, associated with horse and mammoth remains,[3] in deposits of muck in regions which are now treeless.

Judging from the number of separate bones, tusks, teeth, etc., collected or examined in 1907 and 1908 mammoth was everywhere the most abundant animal, bison followed closely, horse and caribou — in about half the quantity of the former genera — came next in the order named, and other mammals were comparatively scarce. In the Eschscholtz Bay region the same sequence holds but the numbers of these four genera are more nearly equal.

List of Pleistocene Mammals of Alaska and Adjacent Canadian Territory. [4]

Alaska.	Canada.
Elephas primigenius Blumenbach.	*Elephas primigenius* Blumenbach.

[1] Maddren, pp. 10, 40.

[2] Collier, Hess, Smith, and Brooks, p. 90.

[3] Collier (1), p. 27.

[4] Perhaps *Oreamnos* ought to be included, on the Canadian side, for McConnell (p. 29) says: the "creek gravels" of Klondike River contain "bones of various extinct and still existing northern animals such as the mammoth, the buffalo, the bear, the musk-ox, and the mountain sheep and *goat*."

For brief reviews of the various mammals from Alaska and discussions of several doubtful reports of species not included in the following list, see Gilmore, pp. 26–38 (The Pleistocene Fauna of Alaska).

Alaska.	Canada.
. . . .	*Mastodon americanus*[1] Kerr.
Equus sp. undet.	*Equus* sp. undet.
Bison crassicornis Richardson.	*Bison crassicornis* Richardson.
Bison occidentalis Lucas.	*Bison occidentalis* Lucas.
Bison alleni Marsh.	. . . . . .
. . . . .	*Boötherium bombifrons* [2] Harlan.
Symbos tyrrelli Osgood.	*Symbos tyrrelli* [3] Osgood.
Ovibos moschatus [4] Zimmermann.	*Ovibos moschatus* [4] Zimmermann.
Ovibos yukonensis Gidley.	. . . .
. . . . . .	*Ovis* [5] sp. undet.
Alce sp. undet.	*Alce* sp. undet.
Rangifer sp. undet.	*Rangifer* sp. undet.
Rangifer [6] sp. nov.	. . . . . .
. . . . . .	*Cervus canadensis* [5] (Erxleben).
Ursus sp. undet.	*Ursus* sp. undet.
Canis (wolf) sp. undet.	*Canis* [5] (wolf) sp. undet.
Castor sp. undet.	. . . . . .
Odobenus sp. undet. (Quaternary).	. . . . . .

[1] T. Obalski (p. 216) says that he saw *Mastodon* remains in the Klondike region, Canada Maddren (p. 7) considers this an error, but there are two unquestionable records of the occurrence of *Mastodon* (see Gilmore, p. 30) on branches of the neighboring Indian River, which Obalski and others include in the Klondike region.

[2] Identified from a very good photograph (in the possession of Professor Henry Fairfield Osborn) taken by Mr. T. Obalski at Gold Run Creek, Indian River, near Dawson, Canada, in July, 1903.

[3] An incomplete skull of *S. tyrrelli*, with perfect horn cores, was seen in Dawson in 1907. The specimen had been found in Magnet Gulch, tributary of Bonanza Creek, Klondike R., Canada.

[4] Gilmore (pp. 35, 38) omits *O. moschatus* on the ground that since a skull from Alaska has been described by Gidley as *O. yukonensis* sp. nov. all musk-ox material may belong to the latter species. But inasmuch as Pleistocene remains which have not been distinguished from *O. moschatus* are found in Alaska and Canada it seems better to include both species for the present.

[5] A number of fossils, which had been found on tributaries of Klondike River, Canada, in the vicinity of Hunker Creek, were examined in 1907. The collection included a fairly complete skull of *Canis* (wolf); an incomplete skull of *Ovis*; and a tine, about 18 inches in length, apparently of the antler of an elk (*Cervus*). T. Obalski (p. 216) also mentions having seen remains of elk, (cerf à grands bois) in the Klondike region.

[6] Several scattered limb bones and the lower jaw of a caribou — found on the bluff and beaches near Elephant Point — are very small, though evidently fully developed, and undoubtedly belong to a new species.

Appendix.

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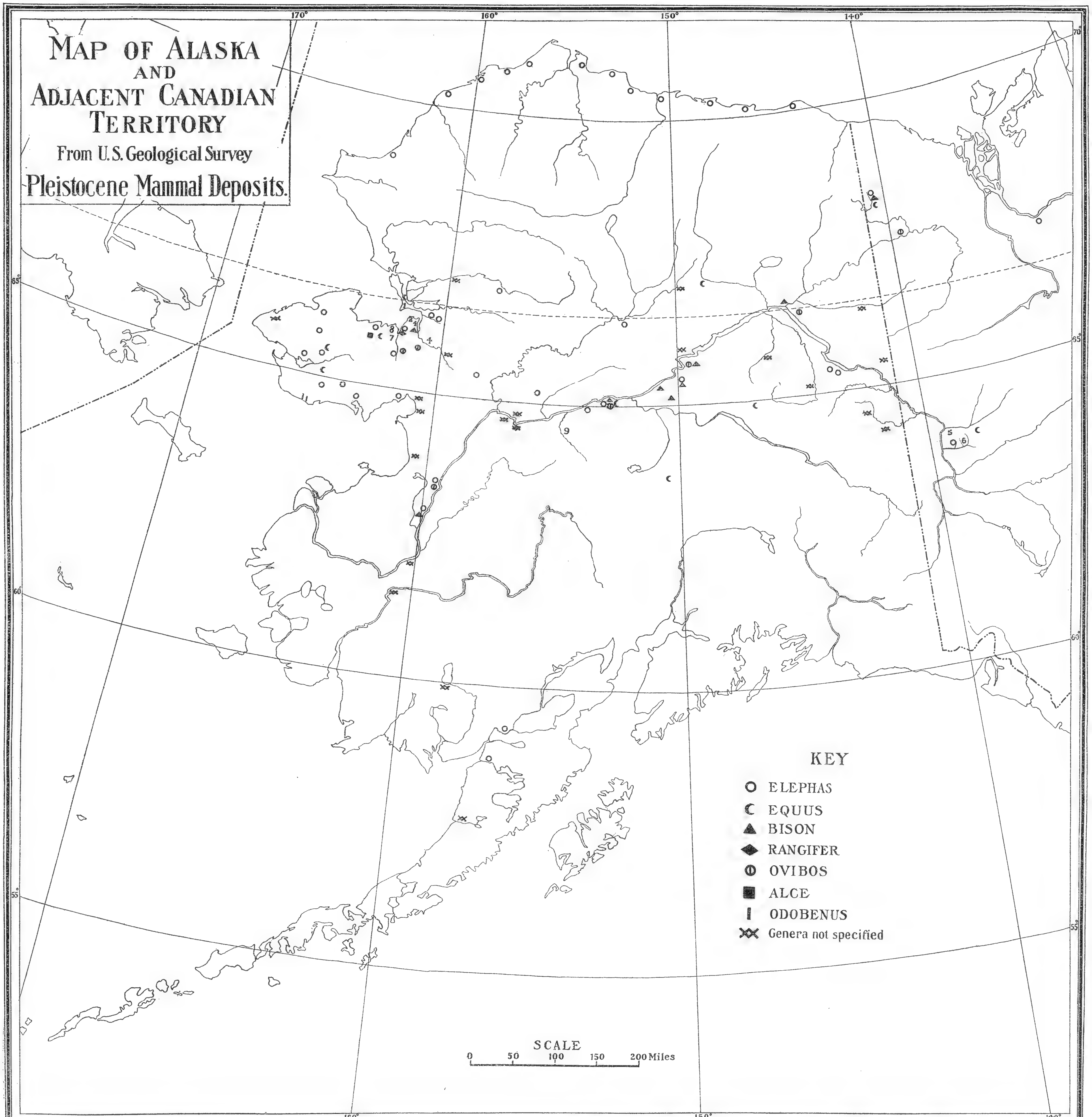
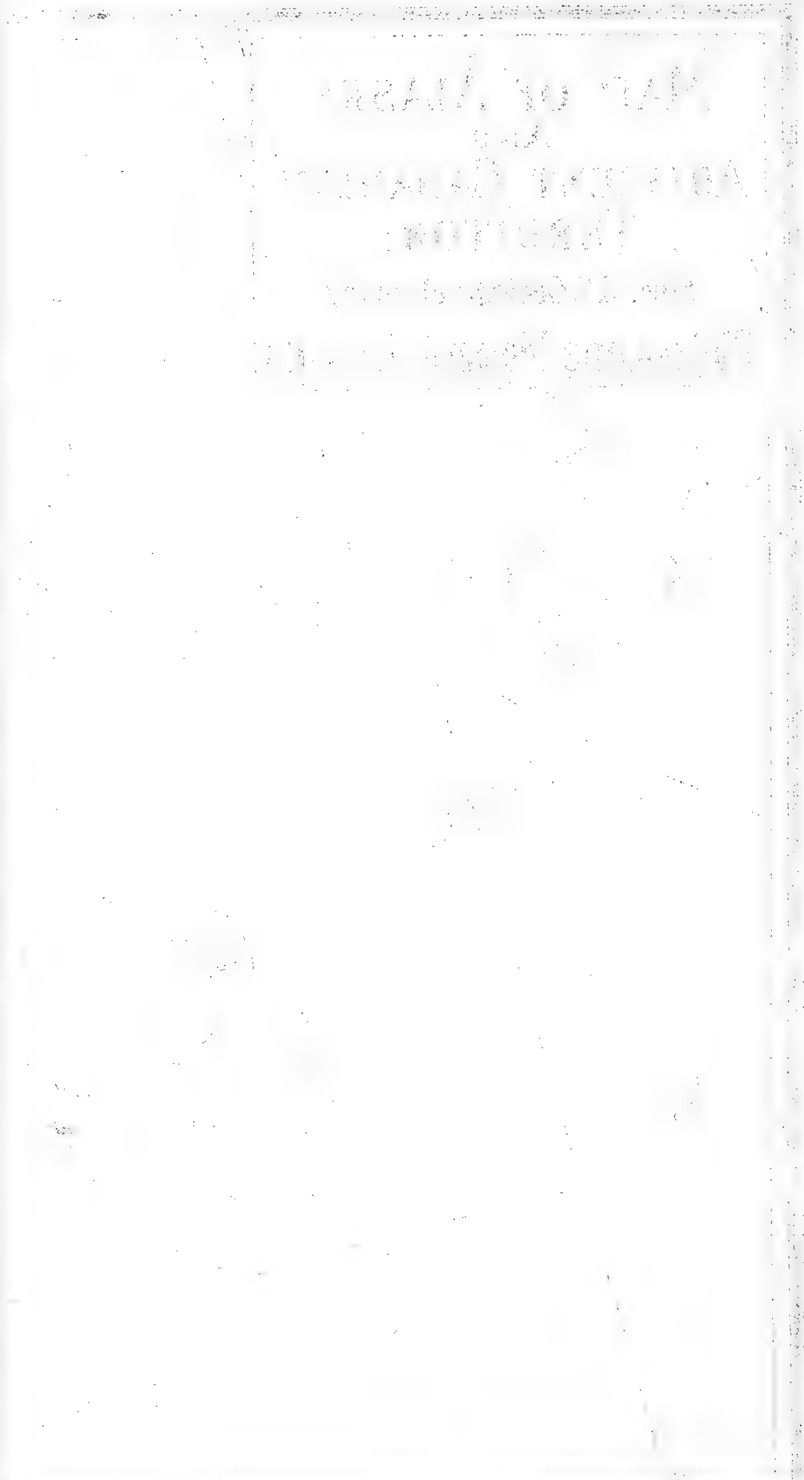


1. Eschscholtz, Bay, north. *Elephas, Equus, Bison, Ovibos, Rangifer, Castor* (dam), *Canis* (Eskimo dog?).
2. Eschscholtz Bay, south (historic bluff and Goose Bay). *Elephas, Equus, Bison, Symbos ?, Ovibos, Rangifer, Rangifer* sp. nov., Alce, *Canis* (wolf), *Ursus, Castor* (dam).
3. (Lost River; see map I, Plate XVIII.)
4. Buckland River, *Elephas, Equus, Bison, Ovibos, Rangifer, Alce, Ursus, Canis* (wolf).
5. Klondike River. *Elephas,* (*Mastodon ?*), *Equus, Bison crassicornis, Bison occidentalis, Symbos, Ovibos, Ovis, Rangifer, Alce, Cervus, Ursus, Canis* (wolf).
6. Indian River. *Elephas, Mastodon, Equus, Bison, Boötherium.*
7. Keewalik River and Lagoon. *Elephas, Equus, Bison, Ovibos, Rangifer.*
8. Alder Creek and Native Gulch. *Bison, Rangifer.*
9. Nowitna (Novikakat) River. *Elephas, Equus, Bison, Ursus, Alce, Castor.*



59.7,58C

Article X.— A NOTE ON THE DOLPHINS (CORYPHÆNA EQUISETIS AND CORYPHÆNA HIPPURUS).

By John Treadwell Nichols.

As the writer knows of no published English description of the two recognized species of Dolphins, which gives the differences between them in a satisfactory manner, a detailed comparison of two specimens of about the same size, in the collections of the American Museum of Natural History, a *Coryphæna equisetis* Linn. from the eastern tropical Pacific (taken in approximately 10° North Latitude and 119° West Longitude), and a *Coryphæna hippurus* Linn. from Sandy Hook, should be useful. Our *C. equisetus* is a female full of spawn, and was obtained from a large school of fish, December 4, 1906.

Coryphæna equisetis Linn.

Length, inclusive of caudal, 14 inches. Length, head and body, 11.4 inches. Weight 12.5 oz. Body moderately compressed, its greatest depth about in the center, tapering evenly towards head and tail. Depth 3.7 in length of head and body. Greatest thickness about 1.7 in head. Least depth of caudal peduncle 4.2. Lower jaw slightly projecting. Head and gill-covers mostly scaleless, except for a scaled area behind and below the eye. About 180 scales in longitudinal series. Lateral line complete. A short arch in it, over the posterior part of the appressed pectoral fin. Head 4.5 in length of head and body. Eye 5 in head. Snout 3. Nostril with double opening, midway between eye and snout. Maxillary 2.5 in head, reaching past front of eye, not quite to anterior margin of pupil. Branchiostegal rays 6 or 7.

Numerous small teeth on jaws. Smaller teeth on vomer and palatines, and a large area on back of tongue with minute teeth. This toothed area with parallel sides, cut by a broad arc in front, and acutely rounded or broadly pointed behind, slightly longer than broad. The tongue itself large, filling the floor of the mouth, truncate in front. Distance from posterior border of teeth on tongue to tip of tongue 5 times in head. Breadth of tongue 5.8. (Fig. 1.)

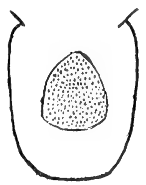


Fig. 1. Diagram of tongue of *Coryphæna equisetis* Linn. Enlarged about one-fourth.

Dorsal long, of 51 rays. Its origin a little in advance of half way between posterior margins of eye and of gill-cover. Dorsal fin so formed that its posterior rays suggest finlets. About 12 of these "finlets" noticeably developed, each with one dorsal ray, except the hindermost with three. Anal resembles dorsal, and has 22 rays, and about 12 finlets suggested posteriorly. These "finlets" are more nearly isolated than the dorsal ones. The last with two rays, the others with one each. Pectorals very small, 2.2 in head, with 18 rays. Ventrals 1.6 in head, pointed about under pectorals, the more sloping ventral outline of the fish

making them appear further back than in our specimen of *hippurus*. Rays I, 5, fins with delicate attachment to middle line of chest, and fitting into a shallow depression, prolonged behind in a narrow crack which does not nearly reach vent. Caudal deeply forked, its dorsal fork slightly longest; the distance from the center of the base of caudal fin to this tip, .9 in head. Longest dorsal ray 3.3 in head. Longest anal ray 5.4.

Color of preserved specimen: Above dusky, becoming paler, vinaceous, on lower parts. Sides with irregular, scattered, small black spots, varying in size, and resembling specks of ink. In fact the writer believed that they were some foreign substance with which the specimen had accidentally become soiled, until similar spots were observed on two specimens of *equisetis* from the Indian Ocean, in the Museum of Comparative Zoölogy, Cambridge, Mass., and also on Günther's figure of the species.[1] Pectoral fins pale, except for the base and upper edge, and the upper part of the side nearest the body, which are dusky. Ventrals mostly pale on their lower side and dusky on the upper side which is appressed to the body. The caudal appears to have been dusky, its central rays tipped with whitish. Dorsal dusky, its posterior part tipped with whitish. Anal whitish, more or less dusky at its base, the last ray whitish.

Coryphæna hippurus *Linn.*

Length inclusive of caudal 17.1 inches. Length, head and body, 13.5 inches. Weight 10 oz. Body compressed, its greatest depth forward of the center, and becoming attenuate towards tail. Depth 4.9 in head and body. Greatest thickness (through posterior part of head) 2.4 in head. Least depth of caudal peduncle 4.2. Lower jaw slightly projecting. Body covered with small scales. Head and gill-covers mostly scaleless. A scaled area behind and below the eye. The scales are more numerous and more crowded than in our specimen of *equisetis*. There are about 250 in longitudinal series. Lateral line complete, its anterior part wavy, its greatest flexure an angular, upward bend about over the center of appressed pectoral fin.

Head 4.6 in length of head and body. Eye 5.2 in head. Snout 3. Nostril nearer front of eye than tip of snout. Maxillary 2.2 in head, reaching about to center of pupil. Branchiostegal rays 6 or 7. Numerous teeth or jaws, some of the front ones enlarged. Area of densely set, small teeth on vomer, palatines and tongue. The area on tongue somewhat oval. Tongue moderate in size, not filling floor of mouth, rounded in front. Distance from posterior border of its toothed area to its tip 6.5 in head. Its breadth 9 in head. (Fig. 2.)

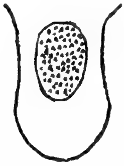


Fig. 2. Diagram of tongue of *Coryphæna hippurus* Linn. Enlarged about one-half.

Dorsal with 56 rays, its origin behind posterior border of eye, but much nearer that than posterior margin of gill-cover. Posterior dorsal rays normal. Anal of 27 rays, the tips of some of them slightly suggesting finlets in appearance. Pectorals falcate, 1.5 in head, of 19–20 rays. Ventrals 1.14 in head, narrowly pointed, fitting into a depression which extends as a narrow crack to vent. Ventral placed directly below pectoral. Caudal deeply forked, the forks

[1] Günther, Fische der Südsee, V, pl. 93.

about equal in length, not as widely flaring as in our specimen of *equisetis.* The distance from the center of the base of caudal fin to its dorsal tip .9 in head. Longest ray of dorsal fin 1.7 in the head; of anal 3.7.

The color of our preserved specimen is silvery, darker on the back, and white on the belly. It shows a regular row of indistinct dark spots along its dorsal outline and a few smaller, indistinct dark spots scattered on the lower part of the sides. The dorsal fin is dusky, the tip of its last ray pale. The anal appears to have been less dusky, and its last ray is light colored. The caudal appears to have been dusky, but invaded by the silver of the flanks; it is noticeably scaled almost throughout. Ventrals whitish below and blackish on the surface, appressed to the body. Pectorals dull yellowish, the base and upper part of the appressed surface dusky.

The writer wishes to call attention to the most striking differences of these two specimens, probably diagnostic of the species which they represent.

(1) The longer, posteriorly more narrowed body of *hippurus.*
(2) Its longer pectoral and ventral fins.
(3) Its larger mouth, stronger dentition and different tongue.
(4) Its much more numerous scale.
(5) Its more numerous fin rays.

The finlet tendency in dorsal and anal fins, particularly noticeable in our specimen of *equisetis,* is probably, to a considerable extent, a matter of individual variation. Our fish possesses it in the extreme, one in the Museum of Comparative Zoölogy shows it, but to a decidedly less degree. If Günther's figure of *equisetis* is correct, the fish from which it was drawn was without such tendency. I believe it to be rare in *C. hippurus,* if it ever occurs markedly.

59.57,92D(7)

Article XI.— THE NORTH AMERICAN SPECIES OF *DIASTROPHUS* AND THEIR GALLS.

By William Beutenmüller.

Plates XXVI–XXIX.

The genus *Diastrophus* contains at present thirteen known species, including *Gonaspis potentillæ*, two of which are found in Europe (*D. mayri*, and *D. rubi*). The genus was first analytically described by Hartig as follows: Maxillary palpi 5-jointed, labial palpi 3-jointed, last joint appendiculate, with *Cynips rubi* as the type. Osten Sacken states that the characters taken from the number of joints of the palpi are, in his opinion, of little practical value, as anybody can satisfy himself by trying to count them, and as for the number of joints of the antennæ, it seems to vary. Osten Sacken, Mayr, Ashmead and other writers have given us detailed descriptions of *Diastrophus*, and Ashmead erected the genus *Gonaspis* for *Diastrophus scutellaris* (= *potentillæ*). Kieffer also places *D. cuscutæformis* in this genus, with which I do not concur. The galls of the species of *Diastrophus* occur on blackberry and raspberry (*Rubus* spp.), *Potentilla* and *Smilax*, and they are as follows:

Galls on the stems or branches of blackberry and raspberry:
- Abrupt, irregularly rounded, or elongate swellings, sometimes with four or five deep longitudinal furrows (on *Rubus villosus*) . . . . *D. nebulosus.*
- Abrupt elongate, soft pithy swellings sometimes more or less covered with spines (on *Rubus strigosus*) . . . . *D. turgidus.*
- Similar in shape to *turgidus* externally, but completely filled with oval, hard larval chambers (on *Rubus nutkanus*) . . . . *D. kincaidi.*
- Small, round, seed-like bodies surrounding a branch in clusters, more or less spined (on *Rubus villosus, canadensis* and *cuneifolium*). . *D. cuscutæformis.*

On or at the roots:
- Irregular, rounded swellings usually in clusters or forming a confluent mass around the root stalk (on *Rubus canadensis*) . . . . . . *D. radicum.*
- Irregularly rounded or ball-like, fleshy swelling at the root or on the stalk close to the ground (on *Rubus canadensis*) . . . . *D. bassetti.*

Galls on *Potentilla*:
- Elongate, fusiform swelling of the stalk. Polythalamous . . *D. fusiformans.*
- Elongate, oval abrupt or blister-like swellings of the stalk and midribs. Polythalmous . . . . *D. niger.*
- A rounded, oval gall or enlargement of a bud, containing an oval larval chamber . . . . *Gonaspis potentillæ.*

Galls on *Smilax*:
- Irregular or rounded swellings on the stems . . . . *D. smilacis.*

Diastrophus *Hartig.*

Cynips (in part) BOUCHÉ, Natur. Ins., 1834, p. 163.

Diastrophus HARTIG, Zeitsch. für Ent. Germar, Vol. II, 1840, p. 186; *ibid.*, Vol. IV, 1843, p. 410; OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. II, 1863, p. 33; MAYR, Gen. Gallenb. Cynip., 1881, p. 25; CRESSON, Synop. Hymen. N. Am., pt. I, 1887, pp. 26, 31; ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294; Psyche, Vol. X, 1903, p. 212; PROVANCHER, Add. Faun. Ent. Can., Vol. II, 1889, p. 158; KIEFFER, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, pp. 91, 92; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, pp. 45 and 73.

Male and female. Head with fan-shaped striæ in front, and a medium elevation, maxillary palpi 5-jointed, labial palpi 3-jointed. Antennæ of female 13–14-jointed, male distinctly 14–15-jointed. Third joint in both sexes longer than the fourth, excised beneath in the male. Head behind the eyes scarcely widened. Mesothorax polished, with the two parapsidal grooves very distinct and usually slightly converging at the scutellum. Scutellum rugose or rugoso-striate with two foveæ at the base; tip of scutellum rounded or obtusely pointed. Metathorax with two straight parallel grooves. Abdomen not petiolate, not compressed, the second segment scarcely covering one half, in the male one third or slightly more than half the abdomen. Ventral spinule scarcely as long as broad. Ventral sheath short scarcely produced. Tarsal claws bidentate. Wings with radial area open at the margin, short or moderately long. Areolet present or wanting.

Type. *Cynips rubi* BOUCHÉ.

Diastrophus nebulosus (*Osten Sacken*).

Cynips (*Diastrophus* ?) *nebulosus* OSTEN SACKEN, Ent. Zeit. Stettin, Vol. XXII, 1861, p. 415.

Diastrophus nebulosus OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. II, 1863, p. 36; MAYR, 20 Jahr. Oberrealsch. I Bez. Wien, 1881, p. 26; WALSH, Am. Ent., Vol. I, 1869, p. 188; RILEY, Johnson's Univ. Encyclop., 1894, p. 659; Am. Ent., Vol. II, 1870, p. 159, fig. 103; FULLER, Am. Ent., Vol. III, 1880, p. 63, fig. 18; PROVANCHER, Can. Nat., Vol. XII, 1881, p. 235; Fauna Ent. Can. Hymen., 1883, p. 550; SAUNDERS, Ins. Inj. Fruits, 1883, p. 318, fig. 332; *ibid.*, 2d edit. 1889, p. 318, fig. 332; ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294; *ibid.*, Vol. XIV, 1887, pp. 134 and 148; Bull. 1, Col. Biol. Assoc., 1890, p. 38; BEUTENMÜLLER, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 249, pl. X, fig. 2; Am. Mus. Journ., Vol. IV, 1904, p. 95, fig. 11; Ins. Galls Vicin. N. Y., 1904, p. 9, fig. 11; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 107; SLOSSON, Ent. News, Vol. VII, 1897, p. 237; WEBSTER, Bull. 45, Ohio Agri. Exp. St., 1893, p. 157; BRIDWELL, Trans. Kan. Ac. Sc., Vol. XVI, 1899, p. 203; KIEFFER, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser. 1902, p. 92; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73; COOK, Ohio Nat., Vol. IV, 1904, p. 119, figs. 143a, b and 129a; 29th Rep. Dept. Geol. & Nat. Hist. Res. Indiana, 1904 (1905), p. 820, fig. 15; JARVIS, Rep. Ent. Soc. Ont., 1906 (1907) p. 72.

Female. Head pitchy black, sometimes tinged with reddish, face sculptured with fine fan-shaped scratches, convergent toward the mouth, along the middle is an elongate, shining, smooth elevation; sides of head and above smooth. Antennæ reddish, sometimes darker at the tips. Mesothorax shining black, smooth, collar

and pleuræ usually reddish, finely aciculated, pleura with a smooth shining area. Parapsidal grooves very deep and prominent, punctate, continuous from the collar to the posterior edge, where they are convergent, but widely separated; median lines wanting. Scutellum with a groove like depression along the middle rounded at apex, very rugoso-striate, subopaque, foveæ at base finely rugose. Abdomen rufous, black terminally, smooth shining. Legs and coxæ yellowish red. Wings hyaline, cross-veins and basal radial vein infuscated. Areolet moderately large, triangular.

Male similar to the female but blacker and wanting the infuscation on the veins. Length, male, 1.50 to 2 mm.; of female 2–3 mm.

Gall. (Plate XXVI, Figs. 1, 2.) On stems of blackberry (*Rubus villosus*). Very variable in shape and size. Round, elongated, or irregular, sometimes with deep longitudinal furrows which divide the gall more or less completely into four or five parts. Dark green, turning reddish as the season advances. Hard, corky or pithy inside with many larval cells. Length 25–75 mm. and diameter about 25–40 mm.

Habitat: Canada (Ontario); New England and Middle States; D. C.; Maryland; Delaware; Virginia; North Carolina, south to Florida; Ohio; Illinois; Indiana; Missouri; Iowa; Wisconsin; Michigan; Oklahoma; Colorado.

Very common and widely distributed. The galls are usually very common and are very irregular in size and shape. The types are in the Museum of Comparative Zoölogy, Cambridge, Mass.

Diastrophus turgidus *Bassett.*

Diastrophus turdigus BASSETT, Can. Ent., Vol. II, 1870, p. 99; ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294.

Diastrophus turgidus ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 134; Bull. 1, Col. Biol. Assoc., 1890, p. 38; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 108; KIEFFER, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, p. 92; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73; JARVIS, Rep. Ent. Soc. Ont. 1907 (1908), p. 89, pl. B, fig. 2; FLETCHER and GIBSON, Rep. Ent. Soc. Ont., 1907 (1908), p. 128.

Rhodites radicum RILEY, Am. Ent., Vol. II, 1870, p. 181, fig. 110; SAUNDERS, Rep. Ent. Soc. Ont., 1873 (1874), p. 7, fig. 1; Ins. Inj. Fruits, 1883, p. 304, fig. 314; *ibid.*, 2d edit., 1889, p. 304, fig. 314; GILLETTE, 27th Rep. Agricul. Mich., 1888, p. 467.

Female. Head pitchy brown black or entirely black, upper part of face rugose, lower part aciculate, much less so than in *nebulosus*, median elevation smooth, broad, impunctured, cheeks and vertex smooth. Antennæ pitchy brown. Mesothorax jet black, smooth, shining; parapsidal grooves deep, very widely separated at the collar, converging at the scutellum and less widely separated than in *nebulosus*. Collar and pleuræ black, sometimes pitchy brown, finely aciculated, pleuræ with a very large polished area. Scutellum, rounded at tip, rugose, foveæ large, deep, smooth. Abdomen pitchy brown or black, sometimes somewhat rufous beneath. Legs dark amber yellow. Wings hyaline veins brown, cross-veins broad, stout, basal radial vein infuscated. Areolet small.

Male. Similar to the female in color.

Length of female 2 to 3 mm.; of male 1.50 to 2 mm.

Gall. (Plate XXVI, Figs. 3, 4, 5, 6, 7, 8, 9; Plate XXVII, Fig. 1). On the stalk of wild red raspberry (*Rubus strigosus*) and probably allied species. Polythalamous. Abrupt pithy swellings surrounding the stem. Irregular in shape, smooth or more or less covered with short spines. Length 25 to 75 mm.; width 15 to 30 mm.

Habitat: Canada (Ontario); New England States to Massachusetts; Ohio; Colorado.

The adult of *D. turgidus* somewhat resembles that of *D. nebulosus*. It differs in having the parapsidal grooves not so widely separated as in *nebulosus*, and the face less coarsely aciculate. It is also as a rule darker in color. *Turgidus* is hardly distinct from *nebulosus*, and may ultimately prove to be the same. The types are in the American Museum of Natural History and American Entomological Society.

Diastrophus kincaidi *Gillette.*

Diastrophus kincaidii Gillette, Can. Ent., Vol. XXV, 1893, p. 110.

Diastrophus kincaidi Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2nd ser. 1902, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73.

Male and *female*. Head black, face coarsely aciculated, median elevation shining, smooth and rather broad, cheeks, occiput and vertex smooth. Antennæ very dark rufo-piceous, almost black. Mesothorax shining black, parapsidal grooves distinct, widely separated at scutellum, but less so than at collar, median groove distinct, but extending only a short distance from scutellum, lateral grooves at base of wings, distinct. Collar and pleuræ aciculated, the latter with a large shining area. Scutellum evenly rugose, much less so than in any other known species of *Diastrophus*, foveæ large, distinct and very finely rugose. Abdomen black, sheath brown. Leg yellowish brown. Wings hyaline, veins brown, cross-veins scarcely infuscated. Areolet large, distinct. Length of male 1.25 to 1.50 mm.; of female 2 to 2.50 mm.

Gall. (Plate XXVII, Figs. 2, 3). On the stalk of blackberry (*Rubus nutkanus*). Polythalamous. Abrupt enlargements surrounding the stalk, very much resembling the galls of *Diastrophus turgidus*, externally. Inside they are literally filled with hard larval cells, which are divided by thin hard partitions and a thin layer of soft pithy substance forms the external portion of the gall. Length 25 to 60 mm.; diameter 12 to 25 mm.

Habitat: California (Alameda Co.); Washington (Olympia; Seattle); Idaho (Cedar Mts.).

This species is allied to *D. turgidus* but is abundantly distinct. It may be easily known by the rugose scutellum and the median groove on the mesothorax. The gall differs from that of *D. turgidus* by being filled with hard, oval, larval chambers.

The types are with Prof. C. P. Gillette. The galls on Plate XXVII, Figs. 2 and 3, I received from Mr. A. L. Melander.

Diastrophus radicum *Bassett.*

Diastrophus radicum Bassett, Can. Ent., Vol. II, 1870, p. 98; Mayr, 20 Jahr. com. Oberrealsch. I Bez. Wien, 1881, p. 26; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294; *ibid.*, Vol. XIV, 1887, pp 134 and 148; Bull. 1, Col. Biol. Assoc., 1890, p. 38; Gillette, Psyche, Vol V, 1889, p. 183. Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 107; Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2nd ser., 1902, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73; Beutenmüller, Am. Mus. Journ., Vol. IV, 1904, p. 95, fig. 12; Ins. Galls Vicin. N. Y., 1904, p. 9, fig. 12.

Rhodites radicum Gillette, 27th Rep. Agricul. Michigan, 1888, p. 467; Gibson, Rep. Ent. Soc. Ont., 1905 (1906), p. 122.

Male and female. Color same as *D. turgidus.* Head with face distinctly aciculate, median elevation very narrow, somewhat carinate, sides and posterior part smooth. Antennæ rufous, darker terminally. Mesothorax smooth, shining, parapsidal grooves distinct, subparallel, widely separated at scutellum, less so than at collar. Pleuræ and collar pitchy black or brown, distinctly, but finely aciculated, the former with a large shining area. Scutellum bluntly pointed, rugose, foveæ large, shallow, and finely rugose. Abdomen black or pitchy brown. Legs yellowish. Wings hyaline, veins brown, and rather heavy. The brown color of the radial vein is wanting before reaching the second cross vein, giving the appearance of being broken. Areolet large, distinct. Length of male 1.50 to 2 mm.; of female 2 to 2.50 mm.

Gall. (Plate XXVII, Figs. 4, 5). On the roots of running blackberry or dewberry (*Rubus canadensis*), and probably allied species. Polythalamous. Brown, pithy and irregular in shape, varying in size from the shape of a pea of two inches or more in length and nearly an inch in diameter. Sometimes the entire root stalk above and below the surface of the ground, is surrounded by almost a solid mass of galls, measuring about three inches in diameter.

Habitat: Canada to North Carolina; Michigan, Colorado.

The fly is allied to *D. turgidus*, but may be readily separated by the absence of the brown color of the radial vein before reaching the second cross-vein. I have taken galls on the roots of the black raspberry or blackcaps (*Rubus occidentalis*) which may prove to be the same as *D. radicum.* According to Bassett the galls also may be found on the roots of the high bush blackberry (*Rubus villosus*). The types are in the American Museum of Natural History and American Entomological Society.

Diastrophus bassetti *Beutenmüller.*

Diastrophus bassettii Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 248, pl. IX, Fig. 7; Am. Mus. Journ., Vol. IV, 1904, p. 94, fig. 9; Ins. Galls Vicin. N. Y., 1904, p. 8, fig. 9.

Diastrophus bassetti Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser. 1902, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73.

Female. Head jet black, shining, jaws rufous, front coarsely aciculate, median ridge exceedingly fine and linear, cheeks and posterior part shining, smooth. Antennæ rufous. Collar and pleuræ rather strongly aciculate, pubescent. Mesothorax black, shining, with a few punctures each containing a microscopic hair, finely aciculate on the posterior edge between the parapsidal grooves and usually along the inner edge of the latter. Parapsidal grooves subparallel, widely separated at the scutellum. Scutellum very rugose. Abdomen pitchy black, sometimes brownish. Legs very dark rufous, finely punctate and distinctly hairy. Wings dusky hyaline, veins dark brown, cross veins and basal vein of radial area distinctly infuscated. Areolet large. Length 2 to 2.50 mm.

Male. Same as the female in color.

Gall. (Plate XXVIII, Figs. 1, 2, 3, 4, 5). On the stems at the roots, or partly below the surface of the ground, on trailing blackberry (*Rubus canadensis*) and probably allied species. Polythalamous. Irregularly rounded or somewhat elongated or almost globular in shape. Composed of a fleshy substance when fresh and pithy when dry and mature. Greenish or yellowish green, tinged with red or sometimes almost entirely red. Diameter from 12 to about 25 mm.

Habitat. New York; New Jersey; Connecticut; Massachusetts; Rhode Island; North Carolina (Black Mts.).

The adult may be known from its congeners by the strong aciculations and the fine linear elevation on the face, the aciculations on the mesothorax, and dark rufous legs and antennæ. It is allied to *D. radicum*. The gall is sometimes quite common locally, reaching maturity late in autumn. The types are in the American Museum of Natural History and American Entomological Society.

Diastrophus cuscutæformis *Osten Sacken.*

Diastrophus cuscutæformis Osten Sacken, Proc. Ent. Soc. Phila., Vol. II, 1863, p. 39; Mayr, 20 Jahr. Oberrealsch. I Bez. Wien, 1881, p. 26; Walsh, Am. Ent., Vol. I, 1869, p. 188; Saunders, Ins. Inj. Fruits, 1883, p. 319; *ibid.*, 2d edit., 1889, p. 319; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294; *ibid.*, Vol. XIV, 1887, p. 134; Bull. 1, Col. Biol. Assoc., 1890, p. 38; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 249, pl. x, fig. 1; Am. Mus. Journ., Vol. IV, 1904, p. 95, fig. 10; Ins. Galls Vicin. N. Y., 1904, p. 9, fig. 10; Webster, Bull. 45 Ohio Agric. Exp. St., 1893, p. 156; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 107; Cook, 29th Rep. Dept. Geol. and Nat. Hist. Res. Indiana, 1904 (1905), p. 820, fig. 14; Jarvis, Rep. Ent. Soc. Ont., 1907 (1908), p. 89; Fletcher and Gibson, Rep. Ent. Soc. Ont., 1907 (1908), p. 128.

Gonaspis cuscutæformis Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, p. 92; Dalla Torre and Kieffer, Gen. Insect. Hymen. Fam. Cynip., 1902, p. 76.

Female. Head pitchy brown or almost black, sometimes dull rufous, especially the mouth parts, face finely aciculate, with a slight elevation along the middle, labrum smooth, shining, cheeks and vertex smooth, posterior part of head finely punctate. Antennæ rufous. Collar and pleuræ rufous, finely aciculate, the latter

with a large shining area. Mesothorax jet black, shining. Parapsidal grooves, subparallel somewhat converging posteriorly. Scutellum bluntly pointed at tip, rufous or piceus, rugoso-punctate with the two foveæ at base very prominent and sometimes shining. Abdomen smooth, shining pitchy brown. Legs and coxæ rufo-testaceous. Wings hyaline, cross vein stout, and infuscated, basal radial vein infuscated. Areolet wanting.

Male: Color and sculpture as in the female.

Length of female 2 to 2.50 mm.; of male 1 to 1.50 mm.

Gall. (Plate XXVIII, Figs. 7, 8, 9, 10). On stalk of blackberry (*Rubus villosus*, *R. canadensis* and *R. cuneifolium*). Monothalamous. Consists of numerous small, globular, woody, seed-like bodies, pressed closely together, each provided more or less with spines or filament. Dark green, turning red as the season advances.

Habitat: Canada (Ontario); New England and Middle States; probably southward to Florida; Illinois; Ohio; Michigan; Iowa; Missouri; Indiana.

The gall is sometimes quite common locally and several hundred are often on a single stalk. It may be readily known by the seed-like bodies, each containing a single larva. Dalla Torre and Kieffer erroneously refer *D. cuscutæformis* to the genus *Gonaspis* of Ashmead. The types are in the Museum of Comparative Zoölogy, Cambridge, Mass.

Diastrophus fusiformans *Ashmead.*

Diastrophus fusiformans Ashmead, Bull. 1, Colorado Biol. Assoc., 1890, pp. 13 and 38; Cockerell, Entomol., Vol. XXIII, 1890, p. 74; Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2nd ser., 1902, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73.

Diastrophus fusiformis Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 107.

Female. "Black, vertex of head, clypeus, mandibles and basal half of abdomen obscure rufous; legs, including coxæ, brownish red. Antennæ 14-jointed, black the 2nd joint one third longer than the fourth. Head closely finely punctate, subopaque; parapsidal grooves broad, deep, complete, with less sharply defined median groove between them. Scutellum rugose. Wings subfuscous, vein black, the areolet large, the cubital cell closed, the vein at base of radial cell arcuated. The abdomen is as long as the head and thorax together, compressed from below and towards apex, the second segment occupying about half its whole surface, smooth and always rufous, the following segments are short and of nearly an equal length, most frequently black, sometimes, though, obscurely rufous toward the tip, and delicately reticulated; the ventral valve prominent, acute. W. H. Ashmead."

Gall. (Plate XXIX, Figs. 15, 16.) On the stems of *Potentilla*. Polythalamous. An elongate, fusiform swelling, sometimes curved, or otherwise deformed. Length 15 to 45 mm. Diameter 5 to 8 mm.

Habitat: Colorado (West Cliff, T. D. A. Cockerell); Washington (Pullman); Garrison, New York (T. D. A. Cockerell); Massachusetts, Miss Cora H. Clark.

This species is unknown to me and Ashmead's description of the adult is here reproduced. The galls occur on different kinds of *Potentilla*. Prof.

T. D. A. Cockerell collected a gall on this plant at Garrison on the Hudson, New York, which in appearance is the same as *D. fusiformans*, and Miss Cora H. Clark sent me fusiform swellings on *Potentilla canadensis* which may also prove to be *D. fusiformans* when the adults are bred from them. The records New York and Massachusetts, therefore are doubtful. The types are in the United States National Museum.

Diastrophus niger *Bassett.*

Diastrophus niger Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 324; Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73.

Diastrophus minimus Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 325; Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73.

Female. Head jet black, shining, mouth parts rufous, face finely aciculate, median elevation broad, smooth, sides and vertex smooth. Antennæ stout, pitchy brown black, first and second joints usually rufous. Mesothorax smooth, shining, varying from rufous to rufo-piceous or black. Parapsidal grooves distinct, widely separated anteriorly, subparallel, suddenly converging at the scutellum, where they are widely separated. Median groove very short when present. Collar shining, slightly aciculate. Pleuræ smooth, shining, rufous. Scutellum varying from rufous to black, rugose, foveæ large, deep, and separated by a fine ridge. Abdomen rufous usually darker dorsally. Legs pale yellowish or rufo-testaceous. Wings hyaline, veins dark brown, first and second cross-veins heavy with a dark cloud at base of radial area. Areolet wanting or scarcely evident. Length, 1 to 1.50 mm.

Male. Head, thorax, antennæ and abdomen piceous or black. Otherwise like the female. Length .50 to 1 mm.

Gall. (Plate XXIX, Figs. 4–13). On the stems, or midribs of the leaves of *Potentilla canadensis.* Monothalamous when single and polythalmous when in numbers. Round, oval or elongate, smooth swellings (Fig. 6) sometimes involving the whole stem. Sometimes in nodules, singly, (Fig. 11) or in numbers, especially when on the midribs (Figs. 13, 14). Green when fresh and brown and pithy when dry.

Habitat: New York; New Jersey; Connecticut; Rhode Island; Massachusetts.

This species will probably be found everywhere locally, within the distribution of its host plant (*Potentilla canadensis*), which is distributed from Canada to Georgia and to Minnesota and Indian Territory. Through the kindness of Miss Cora H. Clark I received a number of galls on the midribs of the leaves and upon the stems, from which I raised many examples of the adults of *D. niger*. *D. minimus* I cannot separate from *D. niger*. This was bred by Bassett from blister-like galls which he supposed to be distinct from the double or confluent galls of *D. niger*. The types of *niger* and *minimus* are in the American Museum of Natural History and the American Entomological Society.

Diastrophus smilacis *Ashmead.*

Diastrophus smilacis Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 135; Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 73.

Female. Head jet black, face very finely aciculated at the mouth, finely punctate above, sides and vertex smooth; median elevation very narrow, smooth. Antennæ rufous. Mesothorax, jet black, polished, parapsidal grooves, distinct, median grooves wanting; collar very finely aciculated anteriorly, sides and pleuræ smooth. Scutellum pointed posteriorly, rugoso-striate, foveæ at base large, finely rugose. Abdomen pitchy brown black, paler beneath, rufous at tip. Legs rufo-testaceous. Wings hyaline, basal radial vein and cross vein infuscated. Areolet large. Length 2.75–3 mm.

Gall. (Plate XXVIII, Fig. 6). On stems of smilax (*Smilax rotundifolia, S. herbacea* and *S. havanensis*). Polythalamous. Irregularly rounded, abrupt, swellings usually surrounding the stems, sometimes resembling the gall of *Rhodites globuloides.* Green when fresh and of a pithy structure. Diameter 16 mm.

Habitat: Illinois; Florida.

The type galls of this distinct species sometimes resemble those of the rose gall, *Rhodites globuloides* Beut. Figure 6 on Plate XXVIII was made from a gall found on *Smilax havanensis* collected by Dr. E. Bessey at Miami, Florida.

The types of *D. smilacis* are in the United States National Museum, and one female cotype in the American Museum of Natural History.

Gonaspis *Ashmead.*

Gonaspis Ashmead, Psyche, Vol. VIII, 1897, p. 68; Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, p. 91; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 76.

Closely allied to *Diastrophus.* Scutellum prolonged, pointed, pyramidal in outline and projecting far over the metathorax; mesopleuræ coarsely sculptured; antennæ of female 13-jointed, of male 14-jointed. Cubitus of wing, disappearing before reaching the first cross-vein. Areolet large and distinct.

Type: *Diastrophus scutellaris* Gillette.

Gonaspis potentillæ *Bassett.*

Diastrophus potentillæ Bassett, Proc. Ent. Soc. Phila., Vol. III, 1864, p. 689; Mayr, 20 Jahr. Comm. Oberrealsch. I, Bez. Wien, 1881, p. 26; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 294; *ibid.*, Vol. XIV, 1887, p. 134; Cockerell, Entomol., Vol. XXIII, 1890, p. 74; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 250; Am. Mus. Journ., Vol. IV, 1904, p. 96, fig. 13; Ins. Galls Vicin. N. Y., 1904, p. 10, fig. 13; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 107; Cook, Ohio, Nat., Vol. IV, 1904, p. 120, fig. 87; Jarvis, Rep. Ent. Soc. Ont., 1907

(1908), p. 89, pl. B, fig. 5; Fletcher and Gibson, Rep. Ent. Soc. Ont., 1907 (1908), p. 128.

Gonaspis potentillæ Ashmead, Psyche, Vol. VIII, 1897, p. 68; Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, p. 92; Dalla Torre and Kieffer, Gen. Insect. Hymen. Fam. Cynip., 1902, p. 76.

Male and female. Head black, finely aciculated in front, median elevation, smooth. Antennæ rufo-piceus. Mesothorax black, smooth, parapsidal grooves finely punctured, slightly converging at the scutellum, median groove from the scutellum extending well forward, the two grooves from the collar reaching the middle of the thorax. Collar and pleuræ tomentose, finely aciculated, including the usual polished area of the pleura. Scutellum pointed at the tip, rugose, foveæ large, shining. Abdomen pitchy brown black. Legs rufo-testaceous. Wings hyaline, basal radial vein and cross-vein infuscated, cubitus disappearing before reaching the first cross-vein. Areolet large and distinct. Length of male 2 to 2.25 mm.; of female 2 to 3 mm.

Gonaspis potentillæ var. **scutellaris** Gillette.

Diastrophus scutellaris Gillette, Bull. Ill. Lab. Nat. Hist., Vol. III, 1891, p. 191; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 108.

Gonaspis scutellaris Ashmead, Psyche, Vol. VIII, 1897, p. 68; Kieffer, Bull. Soc. Hist. Nat. Metz, Vol. X, 2d ser., 1902, p. 92; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 76.

Differs from *potentillæ* by having the abdomen red or yellowish red instead of black.

Gall. (Plate XXIX, Figs. 1, 2, 3). On the axils of leaves of *Potentilla canadensis*. Monothalamous. Spherical or oblong, usually pointed at the base. Green in summer and brown, pithy in winter. Inside it is soft, spongy and contains an oval, hard, larval cell. Diameter 8 to 12 mm.

Habitat: Ontario, Nova Scotia, Canada; New England States; Middle States; Ohio; Illinois.

I have bred *Gonaspis scutellaris*, which is nothing more than a variety of *G. potentillæ*. I have bred *scutellaris* from galls identical with those of *potentillæ*. The types of *potentillæ* are in the American Museum of Natural History and the American Entomological Society. The type of *scutellaris* is in the Laboratory of Natural History at Urbana, Illinois.

Diastrophus piceus *Provancher.*

Diastrophus piceus Provancher, Add. Fauna Can. Hymen., 1886, p. 161.

Male and female. Pitchy black, face large, rough and shining, vertex finely punctate. Antennæ rufous at base, third joint as long as the fourth and fifth together, moniliform toward the extremity. Pronotum polished, moderately shining. Parapsidal grooves very pronounced. Median groove at base very short. Scutellum very strongly rugose, as much as the metathorax, and without very marked foveæ at the base. Sides rugose, not shining. Wings partly infuscated, veins

black, radial area quite short, three cubital cells, but the cubitus partly effaced at base. Areolet or second cubital distinct, but with the anterior vein slightly marked. Legs reddish, darker at base Abdomen short, black, polished, ventral segments becoming reddish. Sheath scarcely projecting. Length 2.50 mm

Habitat: Ottawa, Canada.

I am unable to recognize this species from Provancher's description, a translation of which is given above. It is probably the same as *D. nebulosus*, *D. turgidus* or *D. radicum*.

59.9(67.6)

Article XII.— MAMMALS FROM BRITISH EAST AFRICA, COLLECTED BY THE TJÄDER EXPEDITION OF 1906.

By J. A. Allen.

The present collection, numbering 205 specimens, represents 56 species and subspecies. The expedition landed at Mombasa, April 27, and arrived at Nairobi, by train over the Uganda Railroad, May 1. From this point a circuitous hunting trip was made to the Athi Plains, the trip extending eastward to Doinyo Sabuk. On returning to Nairobi, the march was continued near the line of the railroad north to Nakaru, and thence still northward nearly to Lake Baringo, passing on the west side of Lake Hannington to Nyamusi, and thence southeastward to Mount Kenia. From Mount Kenia the course was southwestward to Kijabe, and across the railroad to the southern edge of the Mau Escarpment. Later a short hunting trip was made from Maungu, on the lower part of the Uganda railroad.

The principal localities at which specimens were taken are various points on the Athi Plains, May 6 to May 28; Kijabe, June 2–14 and September 18; Elmenteita, June 26–30; Nakuru, July 2–10; Solai, July 24–29; Lake Hannington, August 1–3; Nyamusi, August 2–8; Laikipia, August 10–21; Guasinarock, August 22 to September 2; the western slopes of Mount Kenia, September 12; Nyeri, September 13; Maungu, October 12.

The collection consists principally of medium to large-sized species, it containing only a few rodents and insectivores, and no bats. Nineteen species and subspecies of Antelopes are represented, in several instances by series of from five to ten specimens of each. There is also a fine series of the Grant Zebra, and complete skeletons of the Giraffe and Rhinoceros. All the specimens, with few exceptions, were carefully measured in the flesh, ten measurements of each being taken with a view to their use in mounting the specimens for exhibition. Of these three — total length (in a straight line) from the tip of the nose to the end of the vertebræ of the tail, length of tail vertebræ, and height at shoulders — are generally given in the following annotations, together with the principal measurements of the adult skulls, as a contribution to a better knowledge of the species to which they relate.

The skins were so carefully prepared in the field that they reached the Museum in excellent condition, and surprisingly few of the skulls are defective. This is due to the care, skill, and tireless energy of Mr. Herbert Lang, of the American Museum, who accompanied the expedition as preparateur, and to whom is mainly due the large number and fine condition of the specimens brought in by the expedition. To Mr. Tjäder's skill with

the rifle is of course due the material that came into Mr. Lang's hands for preparation, during the four months the expedition was in the field. The expedition was rendered possible through the very liberal support given it by Mr. Samuel Thorne, of New York City, an esteemed patron of the Museum.

Although the mammal fauna of British East Africa has been liberally exploited during the last twenty-five years or more, as regards especially the larger species, and the recognition of subspecies has perhaps been carried to excess, the present collection has been found to contain a few forms that appear to have not yet been satisfactorily described; at least, I have been unable to recognize them from the very incomplete descriptions thus far published, many of the larger subspecies having been based on fragmentary material in the form of hunters' trophies. The smaller mammals of East Africa doubtless still offer a rich field for the expert collector, since they are easily overlooked by the ordinary explorer and big-game hunter.

1. **Buffelus caffer** (*Sparrman*). Cape Buffalo.

One specimen, adult female, Solai, July 27. Total length, 3180 mm.; tail vertebræ, 800; height at shoulders, 1450. Skull, total length, 520; occipitonasal length, 435; condylobasal length, 480; zygomatic breadth, 43; greatest orbital breadth, 203; breadth above p^3, 163; length of horns, along curvature, 625; greatest spread (outside measurement), 225; distance apart at tips, 426.

2. **Taurotragus oryx livingstonei** (*Sclater*). Livingston Eland.

Two specimens: an old female (now in the collection of Mr. Samuel Thorne), Laikipia, August 10; an old male, Guasinarock, August 27.

The collector's measurements are as follows: Total length, ♀ 2870, ♂ 3100 mm.; tail vertebræ, ♀ 610, ♂ 780; height at shoulders, ♀ 1360, ♂ 1580. The principal measurements of the male skull are: Total length, 470; occipitonasal length, 400; condylobasal length, 420; palatal length, 210; zygomatic breadth, 190; greatest breadth at orbits, 200; mastoid breadth, 78; length of nasals, 200; greatest width of nasals, 45; length of upper toothrow (at alveolar line), 141; length of horns (in straight line) 578.

3. **Tragelaphus tjaderi** sp. nov. Tjäder Bushbuck.

Type, No. 27776, ♂ ad., Nakuru, British East Africa, July 6; Tjäder Expedition.

Top of head yellowish rufous; sides of head lighter and yellower; the nose as far back as the eyes blackish; a very small white spot about an inch below the

posterior canthus of the eye, and another larger white spot about three inches posterior to the angle of the mouth; upper lip in front, chin and throat pure white, forming an oval white patch about 125 mm. long and 45 wide, anteriorly extending to the lips; another oval white patch on the lower throat, about 65 mm. long with the greatest width 45 mm.; a crescent of white on the front of the lower neck, about 30 mm. wide antero-posteriorly and 110 in transverse extent; also a large white spot at inside of shoulder; middle of dorsal region yellowish brown, passing posteriorly into yellowish rufous on lower back and thighs, with a conspicuous crest of lengthened hairs extending from the shoulders to the base of the tail; sides of the body and ventral surface dusky chestnut, darker and less rufous than the mid-dorsal region; a narrow median line of white on lower abdomen; neck yellowish gray-brown all round, a little darker dorsally; fore limbs blackish brown externally, somewhat lighter internally as far as the carpal joint; thence distally a dusky front line to fetlocks where it expands and covers the whole foot, except the toes, which are creamy white in front, from hoofs to dewclaws, the whitish area divided mesially by a broad dusky line; sides of fore limb, from "knee" nearly to fetlocks, yellow orange; hind limbs dark brown to hocks, then bright yellowish-brown laterally, with a broad front stripe of cream white (nearly pure white mesially) extending from the hock nearly to the fetlocks, gradually narrowing distally; fetlocks and pasterns dark brown, with a pair of elongate yellowish white patches, divided by a narrow dusky line, on front of pasterns; tail bushy, rufous above, darkening apically, with the sides and lower surface clear white and the tip black. No white bands, stripes or spots on the body, and no white line from the eye.

Total length, 1450 mm.; head and body, 1230; tail vertebræ, 220; height at shoulders, 820. Skull, condylobasal length, 218; palatal length, 123; length of nasals, 85; greatest breadth, 97; mastoid breadth, 84; breadth above m^2, 75; upper toothrow, 67; lower jaw, incisive border to angle, 173; height, angle to coronoid, 86; lower toothrow, 71; diastema, 50. Length of horns, following curvature, 215; distance between points, 95.

Represented only by the type, a fully adult male, with somewhat worn teeth.

This species is evidently closely related to *T. delamerei* Pocock, from Sayer, Somaliland, based on a single subadult male without horns (probably really a female), with which it agrees in most of the markings, but from which it differs in having the lower parts much darker instead of lighter than the back; the much larger size of the white patches on the foreneck; the long white band on the front of the hind leg (representing the dark stripe on the fore legs), instead of "hind legs colored like the fore legs," etc.; and the presence of a conspicuous dorsal crest. Geographical considerations also favor their being distinct.

4. **Oryx beisa** (*Rüppell*). Beisa Antelope.

Three specimens, two adult males and a young male: Lake Hannington, 2 specimens, August 1; Guasinarock, 1 specimen, Sept. 1.

The two adult males measure respectively as follows: Total length, 2030, 2100 mm.; tail vertebræ, 440, 450; height at shoulders, 1200, 1260. The two skulls measure respectively: Greatest length (= occipitonasal),

380, 385, condylobasal, 345, 357; palatal, 223, 210; length of nasals, 152, 149; zygomatic breadth, 139, 136; upper toothrow, 106, 97; length of horns, 748, 793.

5. **Gazella granti granti** (*Brooke*). Grant Gazelle.

Seven specimens: Komarock, 3 males, two very old and one young adult, May 18; Zebra Farm, Athi Plains, 3 specimens, adult male and female and a young one about six days old, May 25 and 26; Nakuru, adult female, July 4.

The dark markings on the face, the flank stripes and pygal bands vary individually, all being well developed in young animals and more or less obsolete in both the old males and old females.

The external measurements are as follows:

27784,	old ♂,	total	length,	1760;	tail	vert.,	290;	height	at	shoulders,	980.
27785,	" ♂,	"	"	1630;	"	"	300;	"	"	"	930.
27783,	adult ♂,	"	"	1480;	"	"	320;	"	"	"	940.
27786,	old ♀,	"	"	1460;	"	"	270;	"	"	"	820.

A young male, about six days old, differs from the adults in general coloration and in various details. The dorsal surface is grayish fulvous, slightly varied with black-tipped hairs, particularly on the thighs and hind limbs; pygal stripes faintly indicated by narrow transverse blotches of blackish hairs intermixed with pale grayish fulvous; flank stripes broad and black; no dark spot above the eye; crown dusky gray; no pygal white area, the color of the back being continued to the base of the tail, which for the basal inch is like the back, the rest of the tail intense black.

6. **Gazella granti notata** *Thomas*. Thomas Gazelle.

Four specimens, all from Laikipia plateau, at about 6000 feet altitude: Nyamusi, old male, Aug. 7; Laikipia, an old male and a young male, Aug. 11 and 20; Guasinarock, an old male, Aug. 25.

These specimens are rather deeper colored or more rufous than the series of true *granti* from the plains to the southward, and present a similar range of individual variation in color, the flank stripes being absent or obsolete in the old examples and strongly marked in the single young male. The external measurements of two middle-aged males and a young adult male are as follows:

27791,	♂,	total	length,	1730;	tail	vert.,	260;	height	at	shoulders,	900.
27792,	♂,	"	"	1680;	"	"	240;	"	"	"	930.
27793,	♂,	"	"	1540;	"	"	300;	"	"	"	950.

The Laikipia plateau specimens are rather smaller than the plains specimens, with less divergent horns, as shown by the following measurements of the horns and skulls of the males of each.

Gazella granti granti.

	Horns.			Skulls.
	Length.	Distance between tips.	Circumference at base.	Condylobasal length.
27784	600	414	178	254
27785	528	327	176	262
27783[1]	523	257	153	254
Gazella granti notata.				
27791	600	173	175	242
27792	548	223	163	238
27793	460	168	170	240

7. **Gazella thompsoni** *Günther*. Thompson Gazelle.

Six specimens, all males, of which four are old and two young; two are represented by skulls only. The localities and dates are: Nairobi, May 6; Athi River Station, May 8; Komarock, May 18; Zebra Farm, Athi Plain, May 25 and 26 (2 specimens); Nyeri, Sept. 13.

Measurements are given of three of the adult males, as follows:

27779, total length, 1140; tail vert., 230; height at shoulder, 640.
27778, " " 1210; " " 210; " " " 680.
27780, " " 1220; " " 220; " " " 700.

Measurements of Skulls.

	27777 ♂	27778 ♂	27780 ♂	27779 ♂
Condylobasal length	192	192	186	182
Zygomatic breadth	79	83	81	81
Interorbital breadth	58	57	55	57.5
Greatest orbital breadth	82	88	85	86
Breadth at lachrymal fossæ	32	35	30	31
Length of horns over curvature	302	312	332	252
" " " in straight line	298	304	325	245
Distance between tips	98	97	110	95

8. **Æpyceros melampus** (*Lichtenstein*). Pallah.

Nine specimens: Big Tree Camp, Athi Plain, 3 specimens, adult male and female, and an embryo, May 22; Zebra Farm, Athi Plain, 1 adult male, skin and skull, May 25; Nyamusi, 1 male, August 2; Laikipia, 1 old male skull, August 18; Guasinarock, 3 specimens, an adult female and 2 young males, August 30.

In two of the 7 skins, there is a very distinct brownish nose stripe; in

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[1] Young adult.

two others the nose stripe is faint, and in the others it is quite absent. The nose stripe is strongest in two of the Guasinarock specimens, while in the third specimen from this locality it is nearly obsolete. The Guasinarock examples strongly approach the face markings of *Æ. petersi*, including the brownish streak in front of the eye. Apparently *Æ. petersi* is merely a subspecies of *Æ. melampus*.

The external measurements of three old males and two old females are as follows:

27697,[1] ♂, total length, 1700; tail vert., 310; height at shoulder, 910.
27794,[2] ♂, " " 1750; " " 360; " " " 920.
27795,[3] ♂, " " 1630; " " 340; " " " 920.
27799,[4] ♀, " " 1530; " " 310; " " " 860.
27801,[5] ♀, " " 1600; " " 300; " " " 870.

The skull and horns of the three males show considerable individual variation. They are all fully adult, with the teeth much worn, but the largest one of the three is apparently somewhat older than the other two, the skull being more heavily ossified and the horns thicker and heavier.

Mr. Oldfield Thomas characterized, some years ago (P. Z. S., 1892, pp. 553, 554), a subspecies of *Æpyceros melampus* from Zomba, British Central Africa, as *Æ. m. johnstoni*, on the basis of shorter horns and narrower, more slender skull. In the following table of the principal measurements of our three males and two females, the measurement given by Thomas of a skull of *Æ. melampus typicus* (from Latakoo, Bechuanaland) and a skull of *Æ. m. johnstoni* are added for convenience of comparison.

Measurements of Skulls and Horns.

Skulls.	27697 ♂	27795 ♂	27794 ♂	27801 ♀	27799 ♀	Æ. m. typ. ♂	Æ. m. john-stoni. ♂
Condylobasal length	250	243	253	251	233	260	255
Palatal length	136	130	145	146	139	—	—
Zygomatic breadth	108	95	96	96	98	—	—
Interorbital breadth	80	70	77	73	70	87	74
Greatest breadth at orbits	114	112	113	102	103	127	113
Breadth just anterior to orbits	72	70	71	66	65	74	60
Greatest breadth at m^{1-2}	78	71	72	70	71	75	69.5
Breadth between alveoli of p^1	30	29	33	29	31	34	29
Horns.							
Length along curves behind	592	530	605	—	—	569	402
Length in straight line	504	474	448	—	—	477	338
Greatest distance apart	445	328	405	—	—	390	250
Distance between tips	403	313	323	—	—	315	250

[1] Athi Plain.
[2] Nyamusi.
[3] Kijabe.
[4] Athi Plain.
[5] Guasinarock.

9. **Cervicapra redunca wardi** *Thomas.* Ward Reedbuck.

Six specimens, 4 adult females, a young male and a young female: Kijabe, June 6; Elmenteita, June 28 and 29; and Nakuru, July 10.

Three adult females measured in the flesh as follows:

27805, ♀,	total length,	1180;	tail vert.,	200;	height at shoulder,	810.
27802, ♀,	" "	1320;	" "	170;	" " "	720.
27803, ♀,	" "	1350;	" "	180;	" " "	740.

Four adult female skulls range in total length from 222–229 (220); condylobasal length, 195–200 (197.5); greatest breadth (posterior border of orbits), 88–100 (94).

10. **Kobus ellipsiprymnus** (*Ogilby*). Waterbuck.

Five specimens, of which 2 (♂ adult and ♂ juv.) were collected at Nakuru, July 2; 1 (♀ ad.) Solai, July 29; 1 (♀ ad.), Laikipia, August 18; 2 (♂ ad.), Guasinarock, Sept. 1 (only one of these is now in the collection). The collector's measurements of the five adults are:

♂ ad.	total length,	2310;	tail vert.,	370;	height at shoulder,	1300.
♂ "	" "	2550;	" "	420;	" " "	1190.
♂ "	" "	2550;	" "	350;	" " "	1300.
♀ "	" "	2090;	" "	400;	" " "	1200.
♀ "	" "	2270;	" "	450;	" " "	1210.

11. **Madoqua langi** sp. nov. Lang Dik-dik.

Type, No. 27832, ad. ♀, Elmenteita, June 29; Tjäder Collection; collected by Mr. Herbert Lang, for whom the species is named.

A little larger than *M. kirki*, and very similar in coloration, but cranial characters radically different. Nasals not reduced as in *M. kirki*, rostrum shorter and premaxillæ not decurved at tip.

Total length, 710 mm.; tail vertebræ,—; height at shoulders, 440. Skull, total length, 119; condylobasal, 103; palatal, 59; greatest breadth, 59; least interorbital, 42; postorbital, 42; mastoid, 39; nasals, length on median line, 24; width at middle, 17; palatal width at m^1, 20; upper toothrow, 37; tip of premaxillæ to p^1, 25; lower jaw, front border of mandible to angle, 88; height, angle to top of coronoid, 44; lower toothrow, 40.

In the coloration of the dorsal surface this species is indistinguishable from *M. kirki*; the ventral surface is pale fawn instead of clear white, strong anteriorly and fading out to nearly white posteriorly; cheeks and sides of neck strong fulvous instead of fulvous gray, and top of head and crown more strongly varied with yellowish rufous.

Strictly comparable skulls of the two species differ greatly in every detail. The skull of *M. langi* is much larger, with much heavier dentition, relatively as well as absolutely. The ventral outline of the rostrum is straight, not arched as in *M. kirki*; the nasals are nearly three times larger, thus greatly lengthening the antorbital portion of the skull; the palatal surface is flat, instead of deeply depressed in the middle, and the premaxillæ are broader and less depressed at the front margin. The distance from the front of the orbit to the end of the premaxillæ is 23 mm.; in *M. kirki* the corresponding measurement is 12 mm. The premaxillæ extend backward to the nasals and are distinctly separated from the maxillæ by a suture; in *M. kirki* the premaxillæ terminate opposite p^1, or become at this point enclosed by the maxillæ. In a young specimen of *kirki* still retaining the milk dentition the premaxillæ can be traced back opposite to the middle of dp^2, where they become covered by the evident closing over them of the maxillæ.

Madoqua cavendishi Thomas, described from near the type locality of *M. langi*, from a young male still retaining the milk dentition, is a much larger animal and very differently colored, being dark fawn above instead of yellowish gray; the skull of "an immature male with the milk dentition still in place," has a total length of 123 mm., while a fully adult female skull of *M. langi* has the total length only 120; judging by the size of skulls of *M. kirki* of corresponding ages, an adult skull of *M. cavendishi* should have a total length of 135 mm.

12. **Madoqua (Rhynchotragus) kirki** (*Günther*). Kirk Dik-dik.

Six specimens: Nyamusi, 4 specimens, August 2; Guasinarock, 2 specimens, Sept. 2. All are adult except one; one lacks external measurements. The collector's measurements of the four adults are as follows:

27836, ♂,	total length,	610;	tail vert.,	20;	shoulder height,	390.
27835, ♂,	" "	600;	" "	30;	" "	390.
27833, ♂,	" "	570;	" "	30;	" "	400.
27831, ♀,	" "	650;	" "	25;	" "	400.

Three male skulls and one female skull measure as follows:

27835, ♂,	total length,	108;	condylobasal,	93;	gr. breadth,	57,	upper toothrow,	35.
27836, ♂,	" "	111;	"	94;	" "	54;	" "	36.
27833, ♂,	" "	111;	"	95;	" "	58;	" "	35.
27831, ♀,	" "	119;	"	96;	" "	55;	" "	34.

13. **Nesotragus moschatus** *Von Düben.* Zanzibar Antelope.

One specimen, an adult male, Kijabe, June 6. Total length, 690 mm.; tail vertebræ, 80; height at shoulders, 360. Skull, condylobasal length, 105; greatest breadth, 60; length of horns, 60.

14. **Raphicerus neumanni** (*Matschie*). Neumann Steinbock.

One specimen, a middle-aged adult male, Komarock, May 16. Total length, 810 mm.; tail vertebræ, 50; height at shoulder, 470. Skull, condylobasal length, 122; greatest breadth, 70; length of horns, 102.

15. **Oreotragus schillingsi** *Neumann.* Schillings Klipspringer.

Two specimens, adult males, Nakuru, July 3 and 10. Of one of them no measurements were taken; measurements of the other are: Total length, 930 mm.; head and body, 850; tail vertebræ, 80; height at shoulders, 510. Skull, total length, 140 mm.; condylobasal length, 122; greatest breadth. 83; length of horns, 87.

16. **Cephalophus grimmia** (*Linnæus*). Common Duiker.

One specimen, a young male (last molar not fully up), Solai, July 25.

17. **Connochœtes taurinus albojubatus** *Thomas.* White-bearded Gnu.

Two specimens, young male and adult female, Stony Athi River Bridge, Oct. 10. (No external measurements).

The female has the throat beard white, and the mane black mixed with white hairs on the outer edges. The young male has the throat beard mixed gray and white, giving the effect of whitish gray; there is a strongly marked rusty gray band across the face just above the eyes, representing the whitish face band in *C. taurinus johnstoni* Sclater, and the mane is black edged with white. This specimen has the appearance of an intergrade between *C. t. albogularis* and *C. t. johnstoni,* indicating that *albogularis* is merely a subspecies of *C. taurinus,* as originally regarded by Thomas.

18. **Bubalis cokei** (*Günther*). Coke Hartebeest.

Eight specimens, of which 6 are adult males; the others are an adult and a young female: Komarock, 4 males, May 16–18; Zebra Farm (Athi Plain), 1 male, May 26; Kijabe, 2 specimens (♂ and ♀), June 2 and Sept. 18; Nakuru, 1 specimen (♀ juv.), July 2.

External Measurements.

—	♂,	total	length,	2100;	tail	vert.,	430;	height at	shoulders,	1250.
27819,	♂,	"	"	2090;	"	"	430;	"	"	1220.
27820,	♂,	"	"	2050;	"	"	410;	"	"	1290.
27817,	♂,	"	"	2010;	"	"	440;	"	"	1210.
27816,	♂,	"	"	1970;	"	"	—;	"	"	1250.
27821,	♂,	"	"	1970;	"	"	400;	"	"	1180.
27818,	♀,	"	"	1940;	"	"	490;	"	"	1150.

Measurements of Skulls.

	27822 ♂	27821 ♂	27820 ♂	27816 ♂ juv.	27817 ♂	27819 ♂	27818 ♀
Greatest length	445	436	438	430	428	405	417
Occipitonasal length	407	408	410	409	406	387	400
Condylobasal length	371	364	368	364	367	351	364
Palatal length	218	218	228	213	217	213	219
Zygomatic breadth	136	126	125	122	129	123	119
Least interorbital breadth	97	90	90	84	91	81	81
Length of nasals	196	203	196	204	191	191	184
Breadth of nasals	38	35	32	30	32	30	31
Upper toothrow	92	85	94	95	90	90	96

Measurements of Horns.

	27822 ♂	27821 ♂	27820 ♂	27816 ♂ juv.	27817 ♂	27819 ♂	27818 ♀
Length along convexity	410	348	343	375	390	360	320
Circumference at base	258	255	210	220	243	227	185
Spread (outside) at outer angle	348	412	391	382	395	380	374
Distance below points	356	350	345	426	265	270	353

This fine series of specimens, all middle-aged or old adults except one (No. 27816, a male with the permanent premolars just coming into use), is of interest as showing the considerable range of individual variation in the size and shape of the horns. This is indicated in respect to the inflection of the points, whether inward or outward, by the lower two lines of the above table of measurements. When the measurements in the lower line exceed those of the line above it, the tips of the horns are directed outward; when they are less, they are directed inward. Thus in No. 27816 they markedly diverge, while in Nos. 27817 and 27821 they even more markedly converge, and thus strongly contrast with most of the others, which are in varying degrees intermediate.

The color variation in this series is comparatively slight.

19. **Bubalis jacksoni** *Thomas.* Jackson Hartebeest.

Three specimens: 2 adult females, Solai, July 26 and 28; Lake Hannington, 1 old male, August 3.

The two females measure, respectively: Total length, 2230, 2100; tail vertebræ, 580, 530; height at shoulders, 1300, 1280. The male measures, total length, 2350; tail, 555; height at shoulders, 1350.

The principal dimensions of the skulls are: Total length (base of horns to tip of premaxillæ), ♂ 520, ♀ 470, ♀ 475; occipitonasal length, ♂ 455, ♀ 434, ♀ 427; condylobasal length, ♂ 490, ♀ 385, ♀ 385; palatal length, ♂ 247, ♀ 235, ♀ 235; zygomatic breadth, ♂ 136, ♀ 130, ♀ 134; least interorbital breadth, ♂ 89, ♀ 88, ♀ 84; length of nasals, ♂ 225, ♀ 218, ♀ 219; breadth of nasals at edge of premaxillæ, ♂ 37, ♀ 32, ♀ 33.5; upper toothrow, ♂ 101, ♀ 92, ♀ 98; length of horns following convexity (on side), ♂ 510, ♀ 415, ♀ 365; circumference at base, ♂ 277, ♀ 215, ♀ 215; distance between points, ♂ 196, ♀ 188, ♀ 197.

20. **Giraffa camelopardalis rothschildi** *Lydekker.* Rothschild Giraffe.

One specimen, a very old male, skin and complete skeleton, Maungu, Oct. 12.

Total height to top of horns, 5200 mm.; height at shoulders, 3115; total length, 4730; tail vertebræ, 940.

Some of the principal measurements of the skull are as follows: Occipitonasal length, 573; condylobasal length, 710; palatal length (on median line), 382; palatal breadth at m^1, 95; zygomatic breadth, 240; mastoid breadth, 178; orbital breadth (posterior border of orbits), 305; length of horn-cores (above midline of cranium), 155; length of premolar-molar series, 154; premolars, 69.

Owing to excessive exostosis, numerous rough bony excrescences have been developed, there being three on the median line in front of the frontal horn, the anterior one one-half as large as the frontal horn itself; there is a small one between the bases of the main horns, and two others symmetrically placed, one on either side of the skull, about four inches above and obliquely posterior to the orbits; also two prominent bony knobs on the inner surface of each of the main (parietal) horns, those on the left being much larger than those on the right. There are also minor but prominent protuberances of bone on the sides of the face and on each malar bone. The bases of the two posterior (occipital) horns were, according to the collector, Mr. Lang, still cartilaginous, and no indication of their presence

Fig. 1. *Giraffa camelopardalis tippelskirchi* Matschie. No. 27752, ♀ juv., Komarock, May 13.

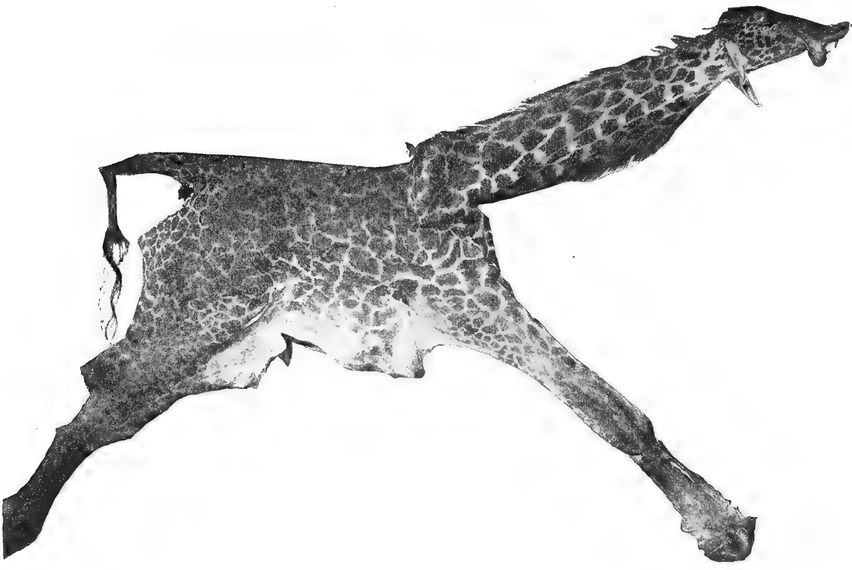

Fig. 2. *Giraffa camelopardalis rothschildi* Lydekker. No. 27753, ♂, very old adult, Maunga, Oct. 12.

is shown by the occipital crest. Externally there were five well-developed horns, the occipital pair, however, being much smaller than those in front of them.

The markings on the body are coarse and large, with the light interspaces very narrow. (See Fig. 1.)

21. **Giraffa camelopardalis tippelskirchi** *Matschei.* TIPPELSKIRCH GIRAFFE.

One specimen, a young female, Komarock, May 13. Total height, 3910 mm.; height at shoulders, 2580; total length, 3730; tail vertebræ (not given).

The sutures of the skull are still widely open and the surface of the bones is smooth. The premolars are none of them fully up, although p^3 has nearly reached its full height, while the crown of p^1 is only just through the gum. Occipitonasal length of the skull, 572 mm.; condylobasal length, 572; greatest width at orbits, 284.

The markings are well shown in the accompanying Fig. 2, from a photograph of the skin. They agree closely with those of a specimen (also a young female) figured by Lydekker,[1] from Lake Eyassi.

22. **Phacochœrus africanus** (*Gmelin*). WART HOG.

Four specimens, one each from the following localities; Big Tree Camp (Athi Plains), adult female, May 22; Elmenteita, young female, June 27; Solai, an old male, July 29; Guasinarock, young male, August 22. Also an embryo, from the female first mentioned.

The external measurements of the old male and the adult female are, respectively, total length, ♂ 1650, ♀ 1470 mm.; head and body, ♂ 1260, ♀ 1100; height at shoulders, ♂ 790, ♀ 650. The skulls of these specimens measure: Total length, ♂ 435, ♀ 360; condylobasal, ♂ 340, ♀ 277; palatal, ♂ 247, ♀ 197; zygomatic breadth, ♂ 208, ♀ 173; interorbital breadth, ♂ 123, ♀ 116; mastoid breadth, ♂ 146, ♀ 118; upper tooth-row, ♂ 90, ♀ 84; length of last molar (at alveolar border), ♂ 37, ♀ 41; greatest spread of upper canines, ♂ 287, ♀ 188; length measured on convexity, ♂ 210, ♀ 123; lower canines, spread at tips, ♂ 252, ♀ 182; length along anterior border, ♂ 120, ♀ 82.

The dental formula of the old male is i. $\frac{1}{2}$, c. $\frac{1}{1}$, pm. $\frac{2}{1}$, m. $\frac{3}{3} = \frac{14}{14} = 28$; of the old female, i. $\frac{1}{3}$, c. $\frac{1}{1}$, pm. $\frac{2}{1}$, m. $\frac{3}{3} = \frac{14}{16} = 30$. In the female m_1 is much reduced in size and greatly worn. In the young male (last molar not

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[1] Proc. Zoöl. Soc. London, 1904, I, p. 214 (text-fig. 28).

fully exposed posteriorly) the dental formula is the same as in the female. In the skull of the young female (about half grown) the number of teeth is the same as in the adult, but the premolars and incisors all belong to the deciduous set. The dentition of the adult female agrees entirely with the illustration of the dentition of *Phacochœrus* given by Owen (Odontog., pl. 141, fig. 2), and that of the young female, with the milk teeth still in place, with the same author's illustration (*ibid.*, fig. 1). In short, the dentition in the present series of *Phacochœrus* conforms entirely with the formulas and detailed description of the dentition of this genus given by Owen in his 'Odontography,' published some sixty years ago. Yet a different dental formula is given in most modern works (giving 34 to 36 teeth), which may be correct for *P. æthiopicus*, but apparently is not correct for *P. africanus*.

23. **Equus burchelli granti** *Winton.* GRANT ZEBRA.

Eleven specimens were obtained, several of them from near the type locality (Theca River, upper Tana River), collected as follows:

Lukania, near Athi River station, adult male and female, May 9; Zebra Farm, near Athi River station, and Kijabe-Naivaska, adult and young, May 26; Elmenteita, two old males, May 27 and 28; Nakuru, adult female, July 6; Laikipia, two adult males, August 18 and 20.

The external measurements of seven adults are as follows:

27747,	♀,	total length, 2460;	tail vert., 430;	height at shoulders,	1270.
27744,	♂,	" " 2400;	" " 450;	" " "	1290.
27742,	♂,	" " 2350;	" " 400;	" " "	1140.
27749,	♂,	" " 2320;	" " 380;	" " "	1250.
27750,	♂,	" " 2440;	" " 400;	" " "	1200.
27743,	♂,	" " 2510;	" " 400;	" " "	1260.
27749,	♀,	" " 2420;	" " 350;	" " "	1230.

The principal measurements of the skulls are:

27743,	♂,	total length, 520;	condylobasal length, 450;	zyg. breadth,	194.
27744,	♂,	" " 530;	" " 465;	" "	193.
27742,	♂,	" " 507;	" " 445;	" "	193.
27749,	♂,	" " 502;	" " 445;	" "	192.
27750,	♂,	" " 520;	" " 455;	" "	193.
27745,	♀,	" " 507;	" " 450;	" "	192.
27747,[1]	♀,	" " 520;	" " 445;	" "	187.
27751,	♀,	" " 507;	" " 445;	" "	184.

The variations in markings and coloration in this series of specimens is quite noteworthy, as might be expected in a species in which the markings

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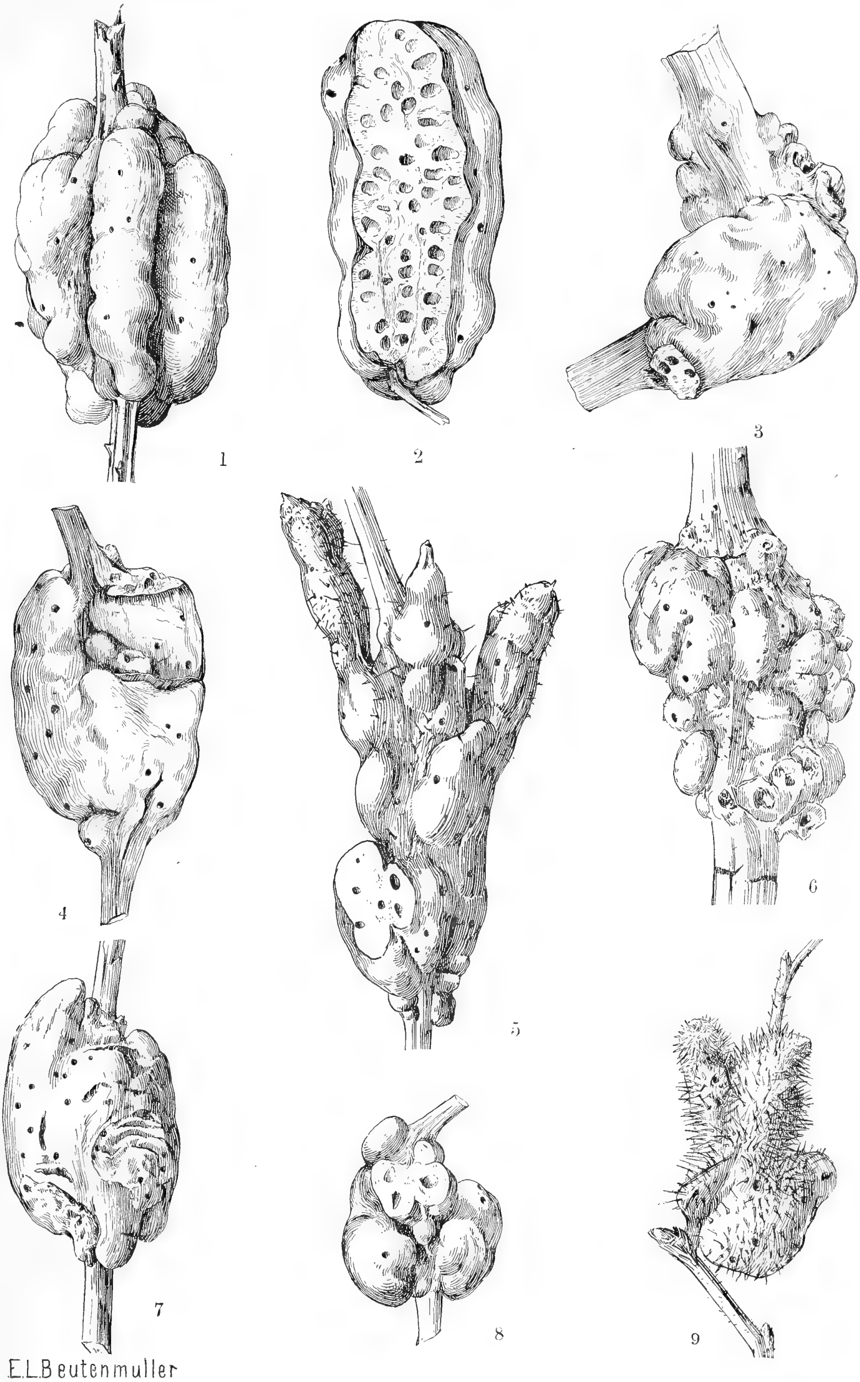
[1] Young adult; p^3 and m^3 just breaking through the alveoli.



1, 2. *Diastrophus nebulosus* O. S. 3–9. *Diastrophus turgidus* Bass.

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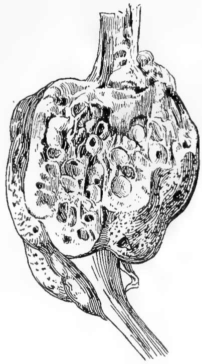

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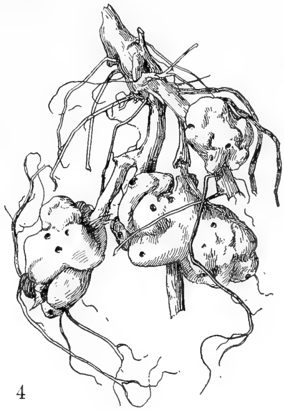

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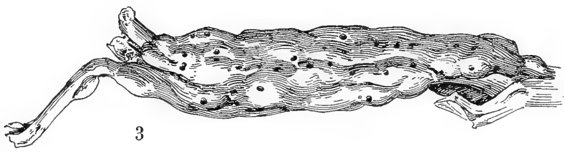

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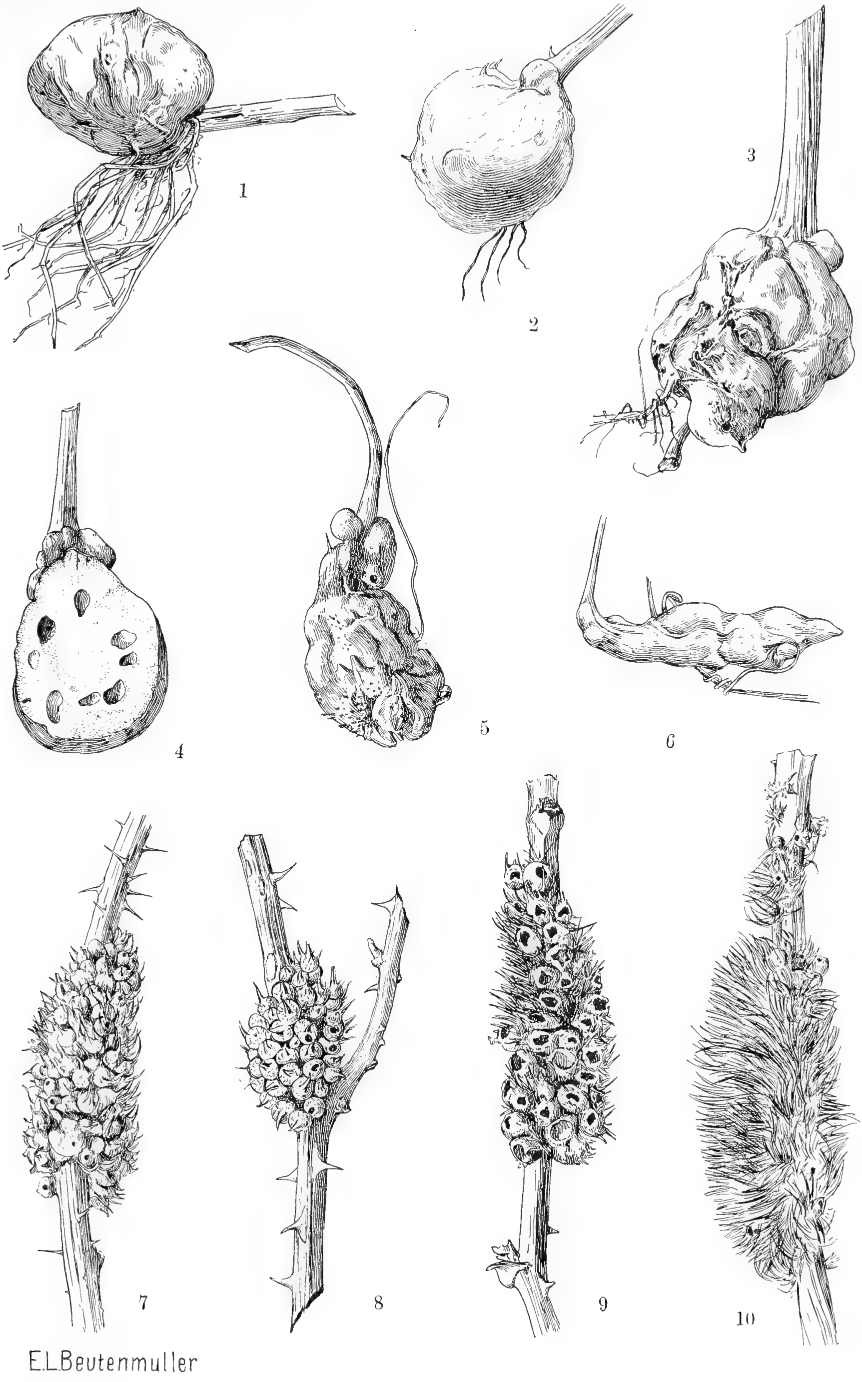
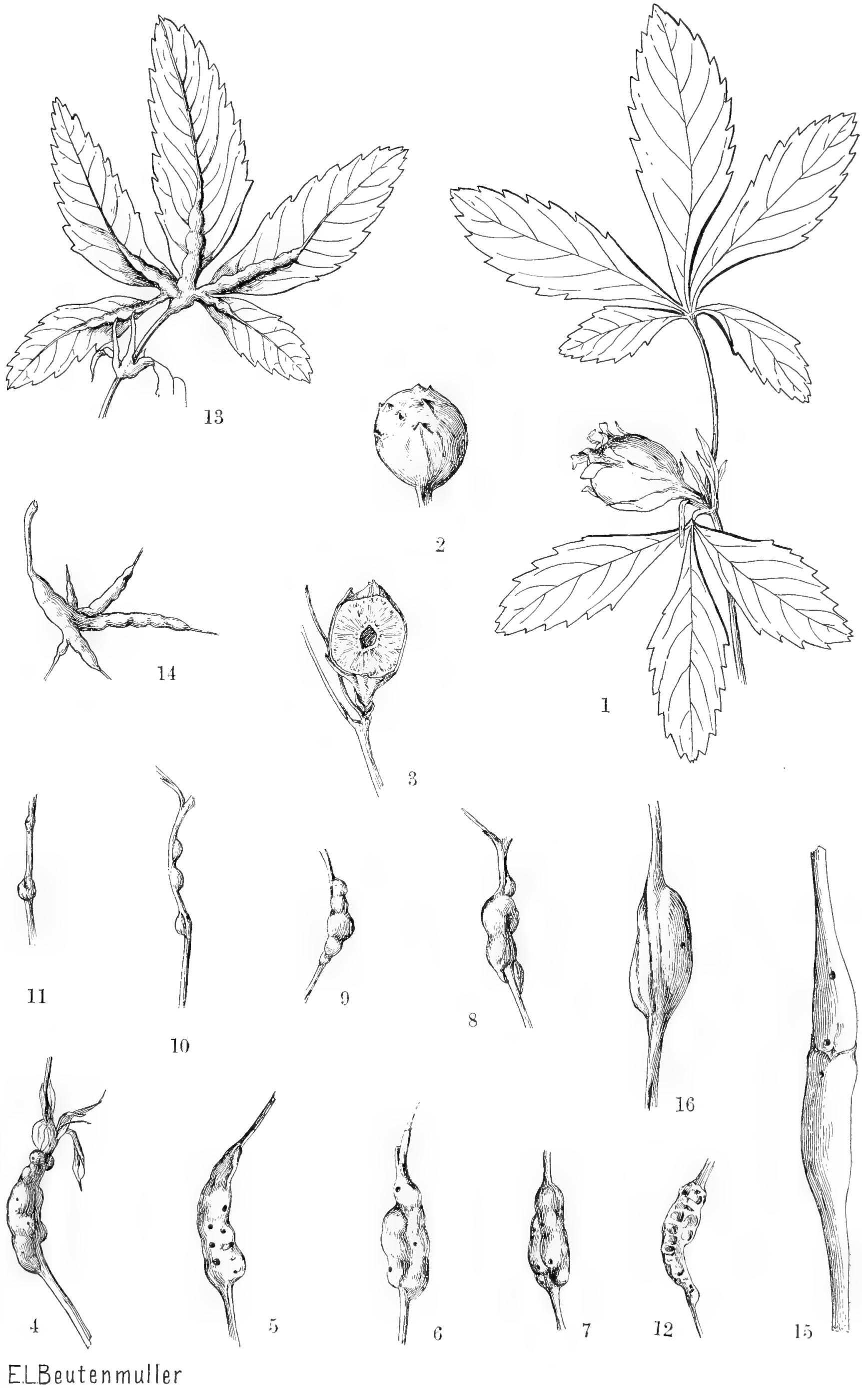
1. *Diastrophus turgidus* Bass. 2, 3. *Diastrophus kincaidi* Gill.
4, 5. *Diastrophus radicum* Bass.



1–5. *Diastrophus bassetti* Beut. 6. *Diastrophus smilacis* Ashm.
7–10. *Diastrophus cuscutæformis* O. S.



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1–3. *Gonaspis potentillæ* Bass. 4–14. *Diastrophus niger* Bass.
15, 16. *Diastrophus fusiformans* Ashm.

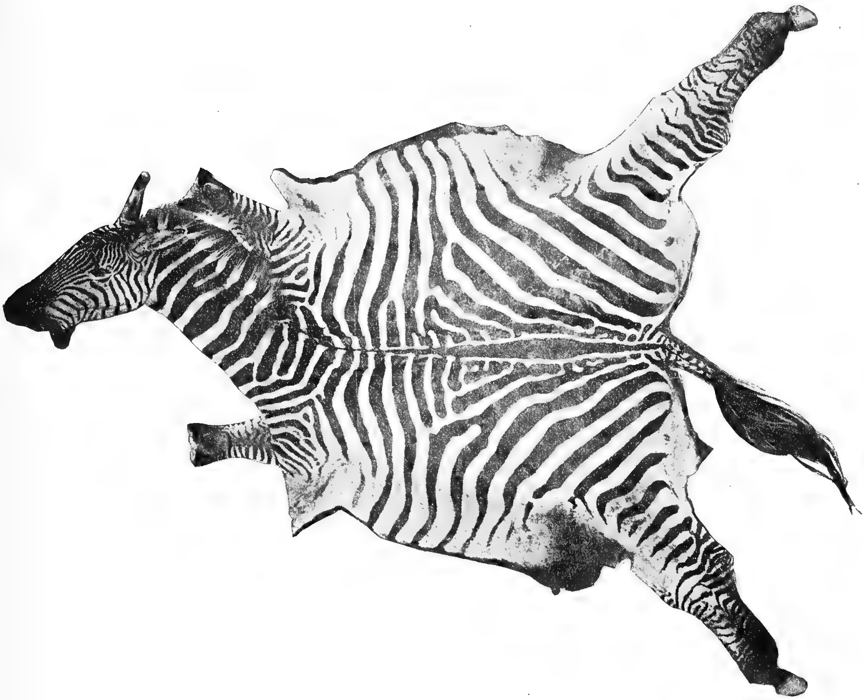

Fig. 3. *Equus burchelli granti* Winton. No. 27742, ♂ ad., Lukania, Athi Plains, May 9.

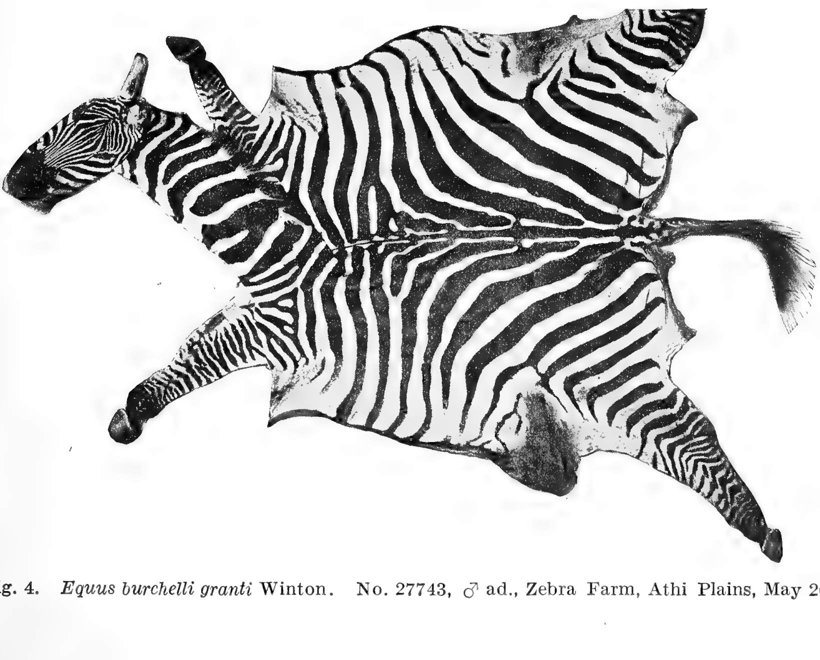

Fig. 4. *Equus burchelli granti* Winton. No. 27743, ♂ ad., Zebra Farm, Athi Plains, May 26.

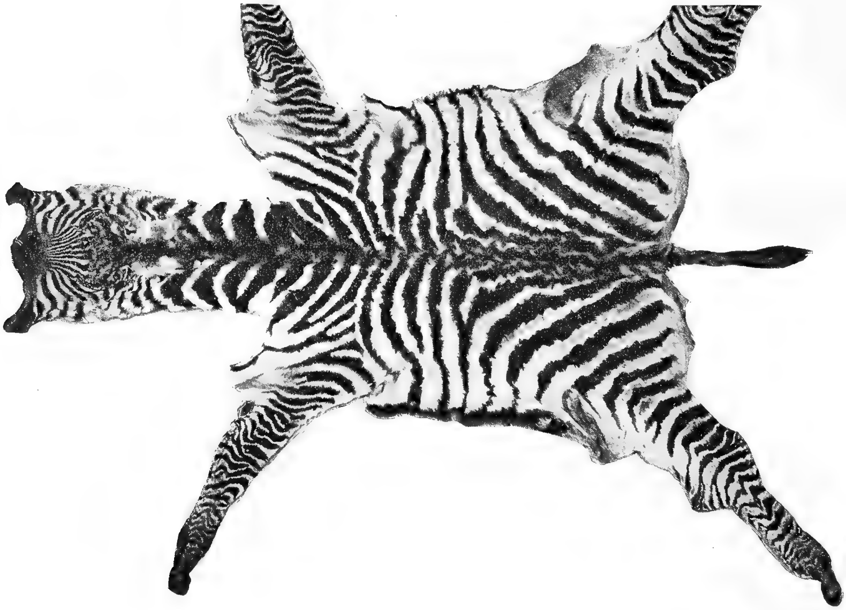

Fig. 5. *Equus burchelli granti* Winton. No. 27746, fœtal specimen from No. 27745 (See Fig. 6).

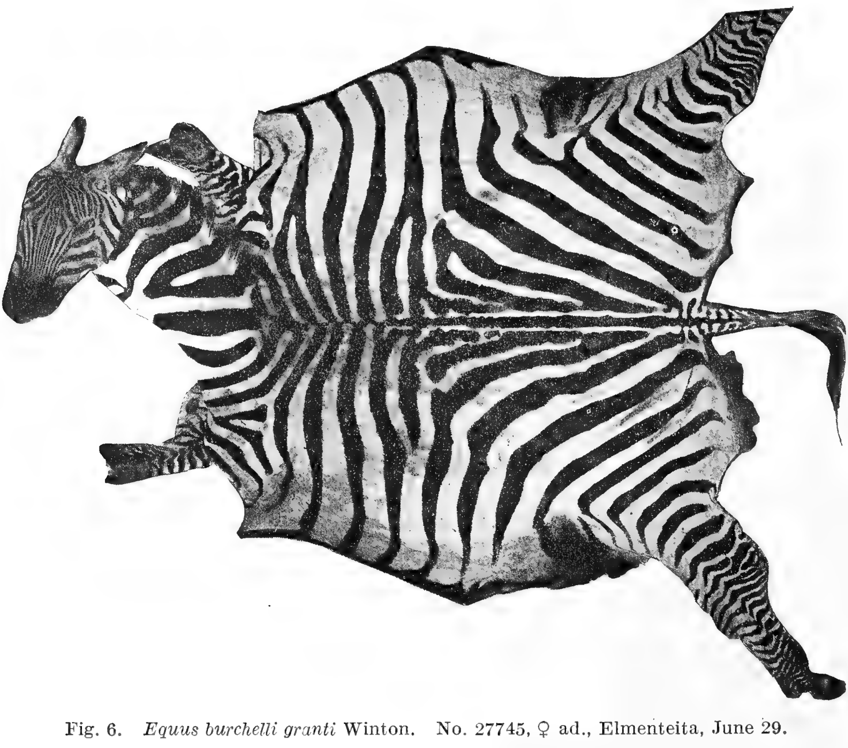

Fig. 6. *Equus burchelli granti* Winton. No. 27745, ♀ ad., Elmenteita, June 29.

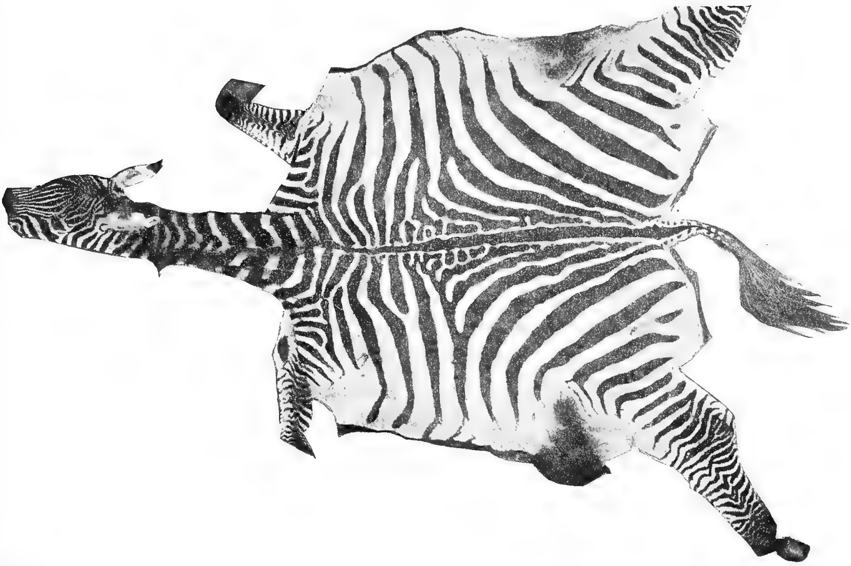

Fig. 7. *Zebra burchelli granti* Winton. No. 27747, ♂ ad., Elmenteita, June 27.

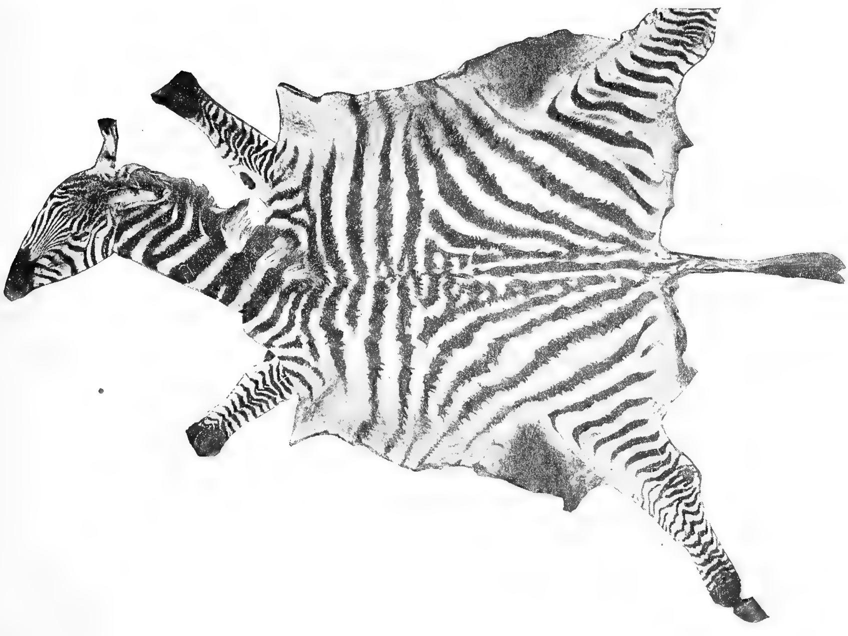

Fig. 8. *Zebra burchelli granti* Winton. No. 27748, ♂ juv., Nakuru, July 6.

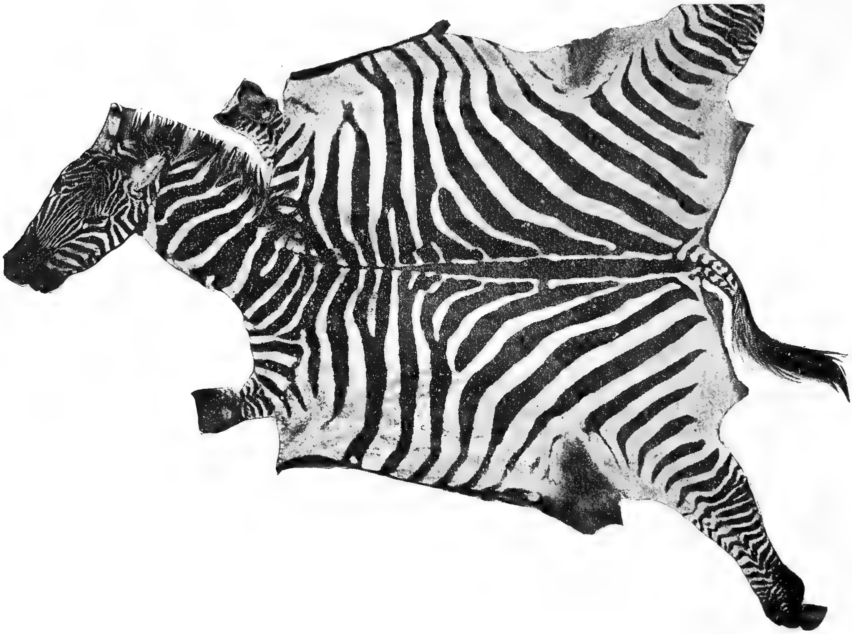

Fig. 9. *Equus burchelli granti* Winton. No. 27750, ♂ ad., Laikipia, August 20.

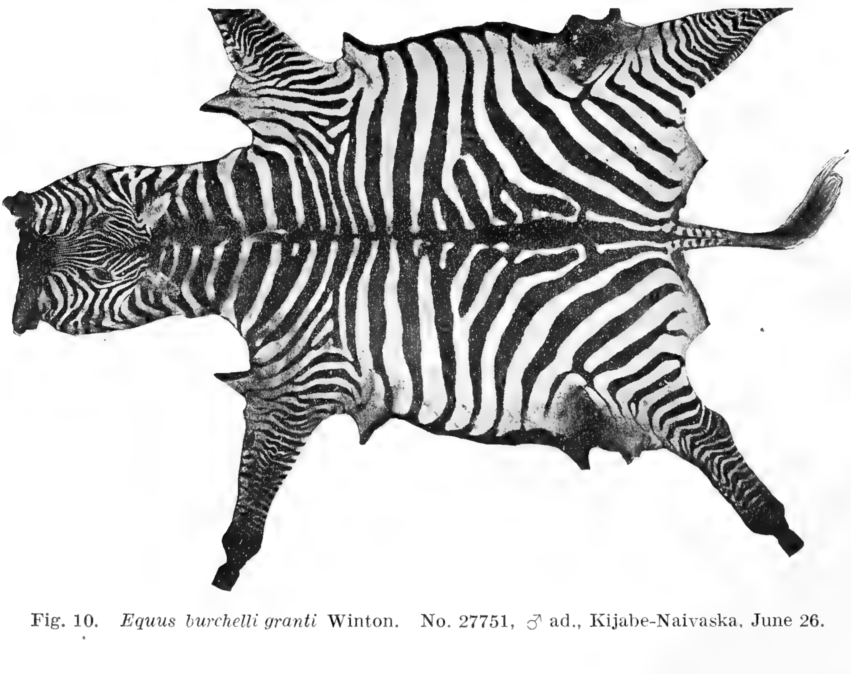

Fig. 10. *Equus burchelli granti* Winton. No. 27751, ♂ ad., Kijabe-Naivaska, June 26.

consist of alternating black and white stripes. The dark stripes vary in color from intense black to dull brown-black; the general ground color of the body from clear white to cream-white; the nose patch from tan-color to dark brownish black. Inasmuch as the dark stripes usually differ more or less on the two sides of the same individual, a wide range of individual variation would be expected, and its extent is well shown in the accompanying text figures (Figs. 4–10). In several specimens there are quite distinct shadow stripes, but as a rule they are absent.

24. **Rhinoceros bicornis** *Linnæus*. Two-horned Rhinoceros.

Seven specimens: Kijabe, 4 specimens, June 10–12; Solai, 2 specimens, July 24 and August 1; Kenia, skull only, Sept. 10.

They include a skin and skeleton of an unborn young, a skin and complete skeleton of an adult male, a head skin and skull of an old male, and three separate skulls, of which two are half grown young and the other a young adult. The external measurements taken by Mr. Lang from the freshly killed specimens are as follows:

27760,	unborn,	total length,		1210;	tail vert.,		240;	height at shoulder,		590.
27759,	♀ juv.,	"	"	2550;	"	"	590;	" "	"	1280.
27754,	♂ juv.,	"	"	2760;	"	"	470;	" "	"	1290.
27755,	♀ juv.,	"	"	3420;	"	"	690;	" "	"	1580.
27758,	♂ ad.,	"	"	3440;	"	"	590;	" "	"	1640.
27757,	♂ ad.,	"	"	3900;	"	"	640;	" "	"	1500.
27756,	♂ ad.,	no measurements.								

The following are the principal measurements of two old adult and two young adult skulls:

Measurements of Skulls.

	27757 ♂ juv.	27756 ♀ juv.	27755 ♀ old	27758 ♂ old
Occipitonasal length	573	550	523	617
Condylobasal length [1]	560	548	518	567
Length of palatines from notch to front border	205	205	195	211
Breadth of palatines at m^1	85	85	80	84
Zygomatic breadth	336	340	329	335
Least postorbital breadth	105	110	98	138
Breadth at lachrymal processes	258	247	223	268
Mastoid breadth	253	233	223	247
Distance between tips (outside) of paroccipital processes	145	138	138	127

[1] To maxillo-premaxillary suture, the premaxillaries in two of the four specimens having been lost.

Measurements of Skulls (continued).

	27757 ♂ juv.	27756 ♀ juv.	27755 ♀ old	27758 ♂ old
Distance between tips (outside) of postglenoid processes	150	139	—	152
Length of nasals	200	188	193	—[2]
Breadth of nasals at base	160	150	152	—
Breadth near tips	144	117	102	145
Length of molar-premolar series	—[1]	—[1]	258	254
Length of premolar series	134	135	128	150

25. **Elephas africanus** *Blumenbach*. AFRICAN ELEPHANT.

Head skin (now mounted) and skull of a male, Nakuru, July 3. External measurements. Total length, 7400 mm.; height at shoulders, 3150; tail vertebræ, 1500.

26. **Procavia jacksoni** *Thomas*. JACKSON DASSIE.

One specimen, adult female, Kijabe.

This specimen agrees very closely, as regards coloration, size, and cranial characters, with Thomas's *P. jacksoni*, based on a youngish female (stage vii), from Ravine Station, British East Africa.

27. **Procavia crawshayi** THOMAS. CRAWSHAY DASSIE.

Two specimens, eastern slope of Mount Kenia (alt. 11,000 feet): an old female (stage viii) which contained on embryo; Kijabe (alt. 7,500 feet), a young male (stage v).

28. **Procavia brucei** (*Gray*). BRUCE DASSIE.

I refer to the *P. brucei* group 4 specimens collected as follows:

Elmenteita, 3 specimens, June 30; Kijabe, 1 specimen, August.

The total length of an adult male (stage viii) from Elmenteita, in the flesh, is 500 mm. The principal measurements of the skulls of this and another old male (both stage viii) from Elmenteita are respectively as follows: Total length, 92, 91; condylobasal length, 86, 84; palatal, 48, 47; greatest zygomatic breadth, 52, 53; length of premolar-molar series, 37, 35.5; diastema, 15, 12.5. The teeth are most worn in the smaller specimen. The other two specimens are respectively in stages v and vi.

The three specimens from Elmenteita were killed on the same day at

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[1] M^1 not fully up.
[2] Sutures wholly obliterated.

the same camp, and were members of a single colony, yet they differ notably in coloration. The oldest specimen, as shown by the worn teeth, is the palest and most fulvous; the other adult male is the darkest and the lower back has a strong suffusion of rufous, which is absent in both the others. The young female is also dark but lacks the rufous tint, the general effect of the upper parts being a dusky fulvous gray. The fourth specimen, from Kijabe, is intermediate between the dark and light Elmenteita specimens. The crown is like the back in all four.

29. **Procavia emini** (?) *Thomas*. Emin Dassie.

One specimen, young male (stage v), Solai, July 25, is very doubtfully referred as above.

This specimen is strikingly different in coloration from any other in the collection, and from all described species except *Procavia emini*, based on a very young specimen (stage i), from Monbuttu, and thus far apparently unique. The present specimen is much older and darker than the type, with the pelage not fluffy nor especially soft. It is possibly only an albinistic example of *P. brucei*. The color above is dull light yellowish brown, the hairs being uniform pale brown from the base to near the tip, which is pale yellowish or buffy. This coloration is uniform throughout the dorsal aspect, from the nose to the tail, including the sides of the body outside of the limbs and ears. The ventral surface, from chin to anal region, is uniform pale yellowish white, the basal half of the pelage darker, pale buffy brown. In dentition and cranial characters it is quite like the specimens referred above to *P. brucei*.

30. **Lepus victoriæ** *Thomas*. Victoria Hare.

Five specimens, Laikipia, August. The collector's measurements of two of the specimens are, respectively, total length, ♂, 500 mm., ♀ 520; tail, ♂ and ♀, 90. Ears, in dry skin, 102, 107, from notch, 81, 87; hind foot (*s. u.*), 101, 97.

The five skulls measure as follows:

27846,	♂,	total length, 83;	basal length, 66.5;	zyg. breadth, 40.
27851,	—	" " 86;	" " 67.5;	" " 41.
27852,	—	" " 87.5	" " 72.	" " 40.8.
27853,	—	" " 87;	" " 71.3;	" " 40.5.

31. **Tachyoryctes splendens ibeanus** *Thomas*. Ibean Earth Rat.

Twelve specimens, of which 10 are adult and 2 are young in the dark gray first pelage. Four were collected at Nairobi, May 3–6, and 8 at Kijabe, June 6–17 and July 19.

None of these specimens is very old, but three of them have the sagittal crest well-developed, but not quite to the extent indicated in Thomas's figure (P. Z. S., 1900, p. 180). The measurements of my largest specimens barely reach 40 mm. for the 'basilar' length, and 30–31 for the zygomatic breadth, as against, respectively, 41.5 and 32.5–34 given by Thomas.

Mr. Thomas gives external measurements for only one specimen, Mr. Makinder's from Nairobi, namely: "Head and body, 188 mm.; tail 57; hind foot, 29; ear, 10. Mr. Lang's measurements of 9 adults are as follows:

Total	length,	210;	tail,	52.
"	"	220;	"	55.
"	"	220;	"	60.
"	"	224;	"	46.
"	"	226;	"	56.
"	"	245;	"	58.
"	"	250;	"	70.
"	"	255;	"	65.
"	"	265;	"	55.

In the above table the specimens are arranged according to age, as indicated by the skulls, and range from young adults to old; only the last three have a sagittal crest, and in these it is not strongly developed.

The Nairobi specimens are much paler than the Kijabe series, including the incisors, which are pale yellow instead of deep yellow. Although the two localities are only a few hundred miles apart, the two forms may be separable.

32. **Arvicanthis pumilio** (*Sparrman*). Striped Mouse.

One specimen, Kijabe, June 2.

33. **Arvicanthis barbara** (*Linnæus*). Barbarous Mouse.

Three specimens: Kijabe, 2 specimens, June 8; Nairobi, 1 specimen, May 2.

The Nairobi specimen is appreciably darker than the others, distinctly suffused with rufous, and much larger, the collector's measurements being, total length, 270 mm., tail, 152. The Kijabe specimens measure, respectively, ♂, 240, 115, ♀, 230, 120. Both are young, while the Nairobi specimen is old, with the teeth well worn, the difference in age apparently accounting for the difference in size.

34. **Arvicanthis nairobæ** sp. nov. Nairobi Mouse.

Type, No. 27877, ♂ ad., Nairobi, British East Africa, May 24, 1906; Tjäder Expedition; collected by H. Lang.

General color above fulvous gray, darker over the median region, lighter on the sides, and faintly suffused with rufous on the lower back and rump, the anterior half of the body being thus paler and much grayer than the posterior third; below whitish, the basal plumbeous portion of the pelage showing more or less through the surface; ventral area not very sharply defined, the whitish of the lower parts gradually merging into the gray of the sides; upper surface of the feet like the sides — fulvous gray sprinkled with dusky; ears short and broad (about 14 by 18 mm. in dry skin), evenly rounded above, covered with very short fulvous gray hairs on both surfaces; tail about one fifth shorter than head and body, sparingly clothed with short hairs (in the type concealing the annulations, in others not obscuring them), the dorsal third black (type) or blackish, the sides and below pale fulvous.

The pelage is rather coarse and harsh, with scanty dark plumbeous underfur; the coarser hairs are plumbeous basally, broadly banded subterminally with buff, and tipped with black, resulting in a buffy gray general tone, finely grizzled with blackish, becoming faintly rufous posteriorly to the rump, which is more or less strongly suffused with rufous at the base of the tail. In general effect externally, both in form, proportions (including the ears and tail) and coloration, this species presents a strong likeness to the pallid forms of the American genus *Sigmodon*. The outer toes, however, are so greatly reduced that both fore and hind feet give the appearance, on casual inspection, of being three-toed.

Total length (type), 260 mm.; tail vertebræ, 116; hind foot (*s. u.*) in dry skin 26. Four adult specimens (3 ♂ ♂, 1 ♀) measure, total length, 262 (250–270); tail, 114 (105–120). Skull, type, total (occipitonasal) length, 34; basilar length, 28; palatal length, 16; nasals (broad and depressed in front, tapering evenly posteriorly from 5 to 1.5 mm.), 13; zygomatic breadth, 17; interorbital breadth, 5; mastoid breadth, 13; upper toothrow, 7.

Represented by seven specimens, of which 4 are adult and 3 young, the smallest being in first pelage, which is soft and long, pale reddish fulvous above varied with brownish black, and white with a fulvous wash below. They were all collected at Nairobi, May 1–21.

35. **Mus kijabius** sp. nov. Kijabe Mouse.

Type, No. 27881, ♂ ad., Kijabe, British East Africa, June 8, 1906; Tjäder Expedition; collected by Herbert Lang.

Above olivaceous gray, the mid-dorsal region heavily lined with black, black prevailing along the median line; below plumbeous gray, washed with pale olivaceous; fore arms and legs blackish plumbeous, in contrast with the color of the flanks; ears of medium size, blackish brown, nearly naked; tail about one fifth longer than head and body, dark brown, naked; fore feet with the carpus clothed with dusky brown hairs, the toes naked, brownish flesh-color; hind feet dark brownish flesh-color, sparsely clothed with short, brown, bristly hairs, the general effect being dark brown with a flesh-color tinge.

Pelage of the dorsal surface consisting of abundant soft plumbeous underfur, with rather coarse overhair which over the mid-dorsal area consist of fine grooved bristles; pelage of the ventral surface soft, thick and plumbeous throughout with very slight olive-gray tips, forming a faint superficial wash, except in one specimen

in very fresh unworn pelage, where the olivaceous gray wash is a prominent feature of the coloration.

Total length (type), 290 mm.; head and body, 137; tail, 153; hind foot (*s. u.*) from skin, 27; ear, dry, 15. Another adult is slightly larger, measuring, total length, 300; tail, 170.

Skull of type (a young adult), occipitonasal length, 34.6; basal length, 33; zygomatic breadth, 14.5; least interorbital breadth, 5.5; mastoid breadth, 14; length of nasals, 12; upper toothrow, 5.3. A second specimen, older with worn teeth: occipitonasal length, 34; length of nasals, 11; mastoid breadth, 13.5.

This species does not seem to closely resemble any previously described. Its dark coloration, particularly of the ventral surface, the dark brown naked tail and ears, and the dark, nearly naked feet suggest *Mus rattus*, but it is a much smaller species, and really quite radically different in details of coloration.

Represented by five specimens, of which 2 are adult, 2 nearly adult, and a young specimen in first pelage, all from Kijabe, June 6–8. The very young specimen is lighter and grayer on the flanks and whitish gray below.

36. **Mus** sp.

One specimen, adult male, Kijabe, June 6. Gray brown, ventral surface fulvous; size submedium, tail much shorter than head and body, feet buffy white. Total length, 255; tail, 117.

37. **Mus** sp.

One specimen, adult female, Zebra Farm, Athi Plains, May 24.

A small species, fulvous brown above with narrow dark median dorsal area and whitish underparts and feet. Total length, 224; tail, 117.

38. **Otomys irroratus** *Brants*. Vley Otomys.

Four specimens, Kijabe, June 7 and 8.

39. **Otomys jacksoni** *Thomas*. Jackson Otomys.

One specimen, Kenai, Sept. 9.

40. **Xerus rutilus** (*Cretzschmar*). Ground Squirrel.

One specimen, adult male, Nyamusi, Aug. 3.

41. **Felis serval** *Schreber*. Serval.

Adult male, skin and skeleton, Kijabe, June 3. Total length, 1160 mm.; tail vertebræ, 360; height at shoulder, 490. Skull, total length, 131; condylobasal, 109; palatal length, 50; zygomatic breadth, 92; breadth (outside) at m^1, 54.5; breadth at outside base of canines, 31; upper toothrow (including canine), 40; length of carnassial on outer border, 13.

Three additional skins, reserved by Mr. Tjäder, vary greatly in depth of color and in details of markings.

42. **Felis leo** *Linnæus*. Lion.

The collection contains a young kitten, killed with the mother on the Guadomurtu River, September 4. The latter, together with a male killed in May on the Kapita Plains are among the trophies reserved by Mr. Tjäder. No measurements were taken.

43. **Cynælurus jubatus** (*Schreber*). Cheetah.

Skull of male (skin reserved by Mr. Tjäder), Nyamusi, August 2. External measurements: Total length, 2060; tail vertebræ, 710; height at shoulders, 760. Skull, total length, 189; condylobasal, 153; palatal length, 70; zygomatic breadth, 128; palatal breadth (outside at m^1), 73; breadth at outside base of canines, 48; upper toothrow (including canine), 55; length of carnassial (outer border), 22.

44. **Ichneumia albicauda** (*G. Cuvier*). White-tailed Mongoose.

One specimen, consisting of the skull and a part of the skin (including the tail and lower part of back), taken at Guasinarock, Sept. 2.

No external measurements. The skull measures, total length, 109 mm.; condylobasal length, 101; zygomatic breadth, 57; length of premolar-molar series, 36.3.

45. **Genetta stuhlmanni** *Matschie*. Stuhlmann Genet.

A single flat skin, without skull, taken at Maungu, October 2, is doubtfully referred to this species, with the description of which it well agrees.

46. **Hyæna crocuta** (*Erxleben*). Spotted Hyæna.

Adult male, Elmenteita, June 27. Pelage harsh, worn and faded, the dark markings dull brown. Total length, 1360 mm.; tail vertebræ,

230; height at shoulder, 730. Young adult male, Kijabe, June 14. Pelage full, long and soft, the dark markings sharp and deep black. Total length, 1280; tail vertebræ, 210; height at shoulder, 650. Also a complete skeleton of a female, Guasinarock, Aug. 24. Measurements not taken.

The skulls measure:

27767, ♀,	total	length,	260;	condylobasal	length,	208;	zyg.	breadth,	163.
27766, ♂,	"	"	242;	"	"	202;	"	"	151.
27765, ♂,	"	"	245;	"	"	204;	"	"	169.

47. **Proteles cristatus** (*Sparrman*). Aard Wolf.

One specimen, adult male, Majimota, August 2.

Total length, 900 mm.; tail vertebræ, 270; height at shoulder, 490. Skull, total length, 141; condylobasal length, 129; palatal length, 80; zygomatic breadth, 82; postorbital processes, 57; width of muzzle at canines, 42; postorbital width, 34.

48. **Canis lateralis** *Sclater*. Side-striped Jackal.

One specimen, adult female, Kijabe, June 11. Total length, 1000 mm.; tail vertebræ, 360; height at shoulder, 460. Skull, total length, 156; condylobasal length, 143; palatal, 78; zygomatic breadth, 80; interorbital, 25; postorbital, 27; width at anterior border of m^1, 46; width at canines, 25.5; length of p^4 on outer border, 15.

49. **Canis mesomelas** *Schreber*. Black-backed Jackal.

Six specimens, Laikipia, Aug. 21, and Guasinarock, Aug. 22 and 25. External measurements were taken of only two adult males, which are respectively as follows: Total length, 1090, 1040 mm.; tail vertebræ, 370, 390; height at shoulders, 450, 460. The skulls measure as follows:

Measurements of Skulls.

Mus. No.	Sex.	Total length.	Condylo-basal.	Palatal length.	Breadth. Zygo-mat.	Inter-orb.	Post-orb.	At m^1	At canine	Length of p^4
27728	?	140	129.5	69	80.3	27.5	33	46	24	16.2
27729	?	154	141	75	90.5	31	32.5	51	26	17.
27730	?	149.5	136	72	86	29	32	46.5	24	15
27731	♂ juv.	151	135	73	82	30	34	48.6	25.7	15.3
27734	♂ ad.	153	137	75	87	29	32.5	48	27	16.3
27736	♀ ad.	143	132	70	82	29	32	46	25	15
Average		148.4	135.1	72.3	84.6	29.3	32.6	47.7	25.3	15.8

50. **Canis variegatus** *Cretzschmar.* Variegated Jackal.

Nine specimens: Elmenteita, 2 specimens, June 30; Guasinarock, 7 specimens, August 22 and 25. Six are fully adult, two are young adults with the dentition just fully developed, and one retains part of the milk dentition. They vary considerably in color, chiefly in respect to the amount of black in the 'saddle-area,' and in the strength of the rufous of the basal portion of the dorsal pelage, which varies from buff or pale yellowish white to dull rufous or rufous drab.

External Measurements.

27734, ♂,	total length,	980;	tail vert., 300;	height at shoulders, 450.
27735, ♂,	" "	1040;	" " 290;	" " " 460.
27726, ♂,	" "	930;	" " 280;	" " " 420.
27737, ♂ juv.	" "	850;	" " 280;	" " " 400.
27725, ♀,	" "	930;	" " 300;	" " " 420.
27733, ♀,	" "	950;	" " 300;	" " " 420.
27740, ♀,	" "	900;	" " 300;	" " " 420.

Measurements of Skulls.

Mus no.	Sex.	Total length.	Condylo-basal.	Palatal.	Breadth. Zygom.	Breadth. Inter-orb.	Breadth. Post-orb.	Breadth. At m^1	Breadth. At canines.	Length of p^4
27737	♂?	163	145	81	80	25	28.5	47	25	16
27733	♀	151	134	73	80	25.5	28	44	24	15
27732	♀	153	136	75	79	23.5	26	42.5	24	15
27735	♀	149	132	73	76	22.5	26.7	43	24	15
27739	♀	147	131	71	78	27	26	42.3	24	14.5
Average		151.5	133.5	74.6	78.7	24.7	27	43.9	24.2	15.1

51. **Crocidura fumosa** *Thomas.* Smoky Shrew.

One specimen, adult female, Zebra Farm, Athi Plains, May 24. Total length, 142 mm.; tail, 48. Skull, condylo-incisive length, 22.4; greatest breadth, 10. Agrees perfectly in coloration with Thomas's description (Ann. and Mag. Nat. Hist. (7), XIV, Sept. 1904, p. 238).

52. **Crocidura kijabæ** sp. nov. Kijabe Shrew.

Type, No. 27890, ♀ ad., Kijabe, British East Africa, June 2, 1906; Tjäder Expedition; collected by H. Lang.

Color above uniform seal brown with a distinct tinge of reddish; slightly paler below; hands and feet colored like the back, well-haired; ears short, broad, about 5 × 8 mm., sparsely covered with short hairs; tail blackish brown, nearly naked, with a few scattered long bristly dark brown hairs on the basal half.

Total length, 201 mm.; tail, 78; hind foot, 19. Skull, condylo-incisive length, 30; greatest breadth, 12; least interorbital breadth, 5.2; upper toothrow, 14.

This species differs from *Crocidura flavescens nyansæ* Neumann,[1] from near Lake Nyanza (exact type locality not stated), in smaller size, relatively much longer tail, and much darker coloration.

53. **Papio cynocephalus ibeanus** *Thomas.* Ibean Baboon.

Two males, Nakuru, July 6. One is old, the other had just reached maturity, the teeth still unworn. The external measurements are, respectively, total length, 1290 and 1100 mm.; tail vertebræ, 520 and 530; height at shoulder, 600 and 460.

54. **Cercopithecus pygerythrus johnstoni** *Pocock.* Mozambique Monkey.

Five specimens, Nyamusi, August 28: 1 adult male, 3 adult females, and 1 young female. The collector's measurements are:

27705, ♂,	total length,	1220;	tail vert., 750;	height at shoulders, 380.
27703, ♀,	" "	1030;	" " 610;	" " " 260.
27704, ♀,	" "	1020;	" " 620;	" " " 260.
27706, ♀,	" "	1000;	" " 560;	" " " 290.
27707, ♀ juv.	" "	690;	" " 410;	" " " 180.

A fully adult male and a fully adult female skull give the following measurements: Total length, ♂ 103, ♀ 90; condylobasal length, ♂ 73, ♀ 62; palatal length, ♂ 39, ♀ 35; zygomatic breadth, ♂ 68, ♀ 58; mastoid breadth, ♂ 57, ♀ 48; upper premolar series, ♂ 24, ♀ 24.

55. **Cercopithecus kolbi** *Neumann.* Kolb Monkey.

Six specimens, Kijabe, June 3–5. Only two are fully adult, a male and a female.

The male has the ventral surface, from the upper part of the breast to the base of the tail, clear dark gray — blackish gray anteriorly passing into lighter, whitish gray posteriorly; and the region at the base of the tail is like the lower back. The female has the underparts a somewhat lighter gray, and the base of the tail is reddish chestnut, much stronger colored than in the male. The young specimens are much lighter below than the adults, the youngest having the ventral surface and inside of the limbs nearly white, the hair fine and silky; the next youngest is nearly similar, but with a smoky hue over most of the ventral region; the next in age is similar but with the

[1] Zool. Jahrb., Abt. Syst., XIII, 1900, p. 544.

ventral region still darker, but the hairs are without distinct blackish annulations; the fourth has the ventral surface sooty gray, the hairs being faintly annulated with dusky. In all the young specimens there is much dull red on the under surface of the base of the tail.

The external measurements of the adult male and female are as follows: Total length, ♂ 1260 mm., ♀ 1140; head and body, ♂ 570, ♀ 500; tail vertebræ, ♂ 690, ♀ 640; height at shoulder, ♂ 360, ♀ 300. Skulls: Total length, ♂ 117, ♀ 103; condylobasal length, ♂ 84, ♀ 73; palatal length, ♂ 43, ♀ 36; zygomatic breadth, ♂ 80, ♀ 67; mastoid breadth, ♂ 60, ♀ 57; premolar-molar series, ♂ 26.3, ♀ 26.

56. **Colobus abyssinicus caudatus** *Thomas.* WHITE-TAILED GUEREZA.

Eight specimens were collected, of which five are in the Museum collection; six were taken at Kijabe, June 3 and 4, and two at Kenia, September 12.

The black on the base of the tail is restricted to the basal four or five inches or less; in some it is more or less diluted with white, as in two half-grown specimens, in which the tail is as in *C. a. poliurus* Thomas, from Lake Rudolf.

The external measurements of an old male, two young adult males, and one old and one young female are as follows:

27711, ♂ old,	total length, 1280;	tail vert., 650;	height at shoulder, 410.
27710, ♂	" " 1150;	" " 580;	" " " 360.
— , ♂ juv.,	" " 1020;	" " 480;	" " " 300.
27712, ♀ old,	" " 1070;	" " 560;	" " " 330.
27713, ♀ juv.,	" " 960;	" " 490;	" " " 290.

An old male skull and a fully adult female skull give respectively the following measurements: Total length, ♂ 119, ♀ 103; condylobasal length, ♂ 90, ♀ 80; palatal length, ♂ 51, ♀ 43; zygomatic breadth, ♂ 85, ♀ 73; mastoid breadth, ♂ 67, ♀ 60; upper premolar-molar series, ♂ 33, ♀ 32.

59.57,2(921)

Article XIII.—A CONTRIBUTION TO THE KNOWLEDGE OF THE ORTHOPTERA OF SUMATRA.

BY JAMES A. G. REHN.

Academy of Natural Sciences of Philadelphia.

Early in the year 1906 the American Museum of Natural History placed in my hands for study a collection of Sumatran Orthoptera. While the actual determinative work on the series was completed the same year, various matters have hindered the completion of the report, which, however, is now based on an almost complete re-examination of the material.

This material was collected in part by Mr. Rudolph Weber on a private estate called Bah Soemboe, situated on the east coast of the island, and in part by Mr. A. S. Schmiedell at Benkoelen, on the west coast. The initials of the collectors given below under each species indicate the localities where the specimens recorded were collected.

The number of species treated in this paper is eighty, of new genera three, of new species seventeen.

My thanks are due to Mr. William Beutenmüller, Curator of Entomology, for the opportunity to examine the collection.

FORFICULIDÆ.

Diplatys ridleyi *Kirby.* One female. (A. S.)

This specimen is slightly larger than Kirby's measurements of the species, which was described from Singapore, but aside from this and a few minor color characters it does not differ from his description.

The pronotum instead of being plain tawny is buffy with a pair of large comma-shaped patches placed laterad on the cephalic portion, while the tibiæ have the median blackish area weaker and more reduced in size than is apparently the case with the type.

Apachyus chartaceus *Haan.* One male. (A. S.)

Pygidicrana imperatrix *Burr.* One individual, sex doubtful as the caudal part of the abdomen is missing. (A. S.)

This species was previously known only from Mons Gédé, western Java.

Chelisoches shelfordi *Burr.* One female. (A. S.)

This species has been recorded previously only from Sarawak, Borneo.

Chelisoches morio (*Fabricius*). One male. (A. S.)

Chelisoches ritsemæ *Bormans*. One male. (A. S.)

This specimen differs slightly from the original description of this species in the exact placing of the tubercles on the forceps and in the blunter tips to the lateral plicæ of the anal segment. In all the other characters, however, the specimen in hand appears to be typical *ritsemæ*. This species was described from Moeara Laboe, Sumatra.

Blattidæ.

Thyrsocera nigra *Brunner*. One male, one female. (R. W.)

Epilampra badia *Brunner*. One male. (R. W.)

Epilampra lurida *Burmeister*. One female. (R. W.)

Epilampra pfeiferæ *Brunner*. One female. (R. W.)

Epilampra structilis[1] n. sp.

Type: ♀; Benkoelen, Sumatra. (A. Schmiedell.)

Closely allied to *E. procera* Brunner from Java, but differing in the smaller size, the slightly different shape of the pronotum and more heavily maculate character of the same, as well as the more distinctly marbled tegmina. This species belongs in the section to which the name *Hedaia* has been applied by Saussure.

Size moderately large; form elongate-ovate; surface subglabrous. Head with the vertex alone not covered by the pronotum, the interocular space narrower ventrad than dorsad; eyes strongly constricted, subreniform, antennæ not exceeding half the length of the body. Pronotum septilateral, slightly transverse, the greatest length contained about one and one-third times in the greatest breadth, the three faces of the cephalic margin with the angles slight and rounded, the two faces of the caudal margin obtuse-angulate, the angle very narrowly rounded; disk considerably depressed laterad, caudal section somewhat elevated. Tegmina exceeding the apex of the abdomen by the length of the pronotum and the exposed portion of the head together, greatest width slightly exceeding that of the pronotum,

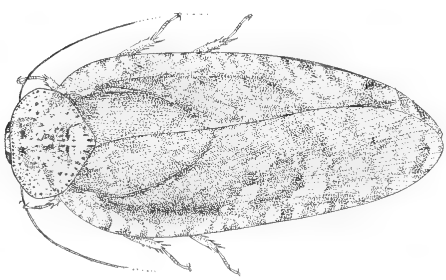

Fig. 1. *Epilampra structilis* n. sp. Dorsal view. (× 1½).

[1] In allusion to the blotched tegmina.

costal margin arcuate in the proximal half, sutural margin nearly straight, apex narrowly rounded and obliquely subtruncate on the sutural side; veins distinctly and finely marked, anal field elongate, subpyriform, the anal sulcus distinct and joining the sutural margin at a point distant from the base about two-fifths the length. Cephalic femora with five or six distinct ventral median spines, median and caudal femora with three to four spines on the ventral margins. Supra-anal plate large, rounded and with a narrow triangular median incision; cerci slightly compressed, blunt, slightly exceeding the supra-anal plate; subgenital plate broad, margin sinuato-rotundate.

General colors bay and cream-buff, the two blotched and stippled one on the other. Head pale with an irregular pattern of dark spots on the vertex; face with a dark transverse rectangular interantennal spot, ventrad of which is a longitudinal bar of the same shade; eyes seal brown; antennæ mars brown. Pronotum pale entirely overlaid with uniformly distributed fine dark points, in addition to which there is a speckling of larger spots of the same color, these becoming tear-shaped along the caudal margin, while there also is a poorly indicated median clepsydral pattern, the swelling dorsad of the insertion of the tegmina rather indefinitely lined as well. Tegmina with the color contrasts quite marked in places and in others broadly blended, the effect being distinctly marbled; the principal points of pale color are two about the middle of each tegmen and several blotches in each anal field, sutural section aside from that of the anal field uniform bay. Abdomen cinnamon, sprinkled with fine dark points laterad and also with a series of lateral spots of the same color. Femora lined dorsad with dark, limbs otherwise chiefly pale cinnamon.

Measurements.

Length of body	29.5 mm.
Length of pronotum	7.9 "
Greatest width of pronotum	9.8 "
Length of tegmen	33. "
Greatest width of tegmen	10.5 "

A topotypic male has also been examined and found to differ in the greater depth and slightly greater extent of the dark margins on the head, pronotum, abdomen and limbs, while the tegmina are really paler, yet the same pattern is present as in the type. The coxæ in this specimen are quiet dark while their lateral margins are very pale, the subgenital plate also bears a median sub-hexagonal dark spot which is represented only by clear uncolored chitin in the type.

Rhicnoda rugosa *Brunner.* One female. (R. W.)

Methana flavicincta (*Haan*). A female specimen in the series had been taken from a bale of Sumatra tobacco received in New York.

Pycnoscelus surinamensis (*Linnæus*). One female. (R. W.)

Pycnoscelus niger (*Brunner*). One female. (A. S.)

Paranauphoeta lyrata (*Burmeister*). One male. (A. S.)

This individual differs very considerably in color from an individual from Trong, Lower Siam, but is inseparable from Kuching, Borneo, material.

Panesthia javanica *Serville.* One nymph. (R. W.)

Mantidæ.

Theopompa burmeisteri (*Haan*). One male, two females. (R. W.)

One female individual is slightly larger than the other, the two also differing in the depth of the clouding of the tegmina. The paler female has the lateral faces of the cephalic femora more tuberculate than the other.

This species was previously known only from Java and Borneo.

Iridopteryx reticulata (*Haan*). One male. (R. W.)

This species has previously been recorded from Krawang, Java and Singapore.

Gonypeta punctata (*Haan*). One male. (A. S.)

Java and Ceylon are the localities from which this species has been recorded. Some doubt is in the mind of the author as to the correct determination of the Ceylonese form as this species. Saussure, who recorded it, gave a detailed description which does not fully agree in several particulars with the specimen in hand, which is identical with Haan's figure and brief description.

Statilia maculata (*Thunberg* & *Lundahl*). One male. (R. W.)

Tenodera superstitiosa (*Fabricius*). One male. (R. W.)

Paratenodera aridifolia (*Stoll*). Two males, two females. (R. W.)

Hierodula hybrida *Burmeister*. Two males. (R. W.)

These specimens fully agree with an individual of the same sex from Batavia, Java, received from the late Dr. Saussure.

Hierodula athene n. sp.

Type: ♂; Benkoelen, Sumatra. (A. Schmiedell.)

Closely allied to the Bornean *H. dyaka* Westwood, but differing in the more robust limbs, the very slightly greater expansion of the pronotum and the non-serrate margins of the same, and in the absence of fulvescent coloration from the base of the tegmina.

Size rather large; form moderately slender. Head rather thick in a cephalo-caudal direction, somewhat compressed and but slightly broader than deep when viewed cephalad; occipital outline gently arcuate, the slope of the occiput cephalad, lateral sulci placed very close to the eyes, no sulci in the median portion; ocelli placed in a somewhat depressed triangle; facial scutellum slightly higher than broad, the greatest width at the base, lateral margins slightly converging to the obtuse angulate dorso-lateral margins, dorsal margin very obtuse-angulate, surface of the plate with a median pair of low dorso-ventral carinæ which are obliterated for a short space immediately ventrad of the middle; eyes ovoid when viewed laterad, rounded, not prominent. Pronotum contained about two and a third times in the

length of the tegmina and with its greatest width contained nearly four times in its length; supracoxal expansion with its transverse axis placed at a distance from the cephalic margin equal to the width of such axis; shaft rather broad when com-

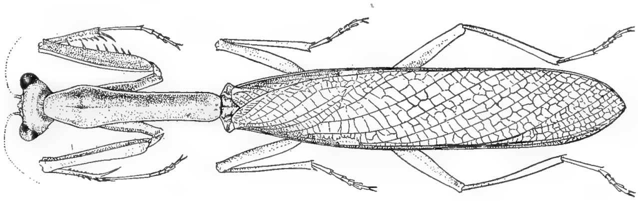

Fig. 2. *Hierodula athene* n. sp. Dorsal view. (Nat. size.)

pared with the supra-coxal expansion, slightly tapering caudad to about the middle, very slightly expanding in the caudal half, margins entire, unarmed. Tegmina extending caudad of the apex of the abdomen by nearly the length of the cephalic femora; entire costal field and the adjacent portions of the discoidal and anal fields opaque, the proximal portion of the discoidal field with a greater width to the opaque section than on the distal portion; stigma ovate, distinct; those portions of the discoidal and anal fields not opaque are markedly hyaline. Wings very slightly extending beyond the tips of the closed tegmina. Abdomen rather broad for the male sex; cerci distinctly but not greatly exceeding the margin of the supra-anal plate, tapering, multi-articulate, provided with short fine hairs; sub-genital plate broad, rather shallow, lateral margins arcuate, thickened, apex broad and with a slight triangular lobe, the thickened lateral margins ceasing each side of the same and bearing thereon a short slender style. Cephalic coxæ robust, ventral margin armed with nine moderately regular dentiform spines; cephalic femora a little more than four times as long as the greatest width, dorsal outline nearly straight, external margin with four spines, internal margin with fifteen spines, both large and small, the formula being as follows reading from the distal extremity mesad, IıııIıIıIıIıIı, discoidal spines four in number; cephalic tibiæ (exclusive of terminal claw) slightly more than half the length of the femora, lateral margin with a small, unarmed area proximad, otherwise with nine to eleven spines, internal margin with no unarmed area proximad and with fourteen spines regularly increasing in size distad; cephalic metatarsi but little shorter than the tibiæ. Median and caudal limbs not slender, moderately robust for the family, the caudal somewhat longer than the median pair.

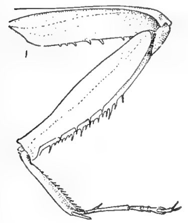

Fig. 3. *Hierodula athene* n. sp. Lateral view of cephalic limb. ($\times 1\frac{1}{2}$.)

General color wood brown washed with greenish and probably entirely green in life. Head ecru drab, eyes raw umber, ocelli ochre yellow. Pronotum with the margins of the shaft dull purple. Tegmina with the opaque portions apple green, stigma cream colored, remainder hyaline. Wings hyaline with the costal margin washed with greenish.

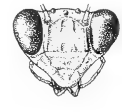

Fig. 4. *Hierodula athene* n. sp. Cephalic view of head. ($\times 1\frac{1}{2}$.)

Measurements.

Length of body	65 mm.
Length of pronotum	23.2 "
Length of tegmen	53.5 "
Length of cephalic femur	16. "
Length of median femur	15. "
Length of caudal femur	16.8 "

The type is the only specimen seen.

Acromantis oligoneura (*Haan*). One male. (R. W.)

Deroplatys desiccata *Westwood.* One female. (R. W.)

Toxodera pluto n. sp.

Type: ♂; Benkoelen, Sumatra. (A. Schmiedell.)

This species differs from *T. denticulata* Serville, from Java, in the slenderer form, the narrower head, the distinctly slenderer pronotum, which is also much more arcuate, the different shape of the femoral lobes and in the arrangement of the spines of the genicular regions. A number of other less striking characters also separate the two species.

Size rather large; form very elongate and extremely slender; surface coriaceous and frequently sub-tuberculate. Head trigonal, broader than deep, occiput with four shallow longitudinal depressions; ocelli placed in a depressed triangle on a slightly elevated base, the lateral ocelli being larger than the median one; facial

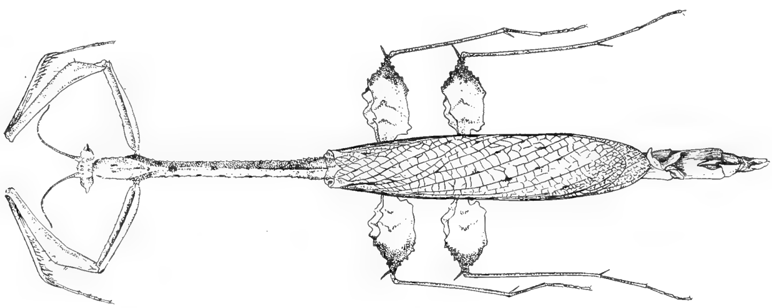

Fig. 5. *Toxodera pluto* n. sp. Dorsal view of type. (Nat. size.)

scutellum strongly transverse, the median section sub-rectangulate dorsad, the lateral sections narrower and slightly bent ventrad; eyes produced, acute mammiform, the terminal process directed distinctly but not greatly cephalad; antennæ slightly longer than twice the extreme width of the head, simple, multi-articulate. Pronotum nearly twice the length of the cephalic femora, sub-bacilliform; collar distinctly broader than the greater portion of the shaft, in length comprising a little more than a sixth of the whole pronotal length; supra-coxal dilation moderate; shaft very

slender and elongate, comprising nearly five-sixths of the pronotal length, somewhat expanding caudad; cephalic margin rounded, caudad margin sub-angulate, lateral margins with low dentiform spinules evenly distributed throughout their length, median carina low cephalad, quite distinct caudad and forming a process at the caudal margin, surface with several pairs of tubercles and a number of single ones placed on or near the median carina, the most conspicuous pair being unequal in height and placed a distance caudad of the transverse sulcus slightly greater than the length of the shaft; when viewed laterad the shaft of the pronotum is seen to be somewhat more arcuate than in *T. denticulata* and decidedly slenderer. Tegmina in length exceeding that of the pronotum by about the width of the head; greatest width contained about four and a half times in the length; apex placed somewhat caudad of the costal margin, sub-rectangulate; costal field moderately broad proximad, much narrowed mesad and distad, coriaceous; remainder of tegmina hyaline. Wings projecting beyond the tegmina by a distance equal to the depth of the head. Abdomen elongate, subequal in width, five proximal segments distinctly longitudinal; caudal margin of the five proximal ventral segments with a short median keeled lobe; third dorsal segment with a pair of foliaceous lobes placed in the form of an inverted V on the caudal section; fourth dorsal segment with a high foliaceous structure in the same position as that on the third segment [1] but very much higher, in fact as high as the segment is long, the two sides united on their converging edges and bearing thereon a foliaceous lappet reaching almost as far cephalad as the cephalic end of the segment and of a semi-circular form with the edge much eroded; fifth dorsal abdominal segment with an appendage similar to that of the fourth segment but only about a third the size and with the lappet much smaller proportionately and merely a narrow lobe; sixth to ninth dorsal segments transverse, the median section of the ventral margin roundly (ninth segment) or angularly (other segments) produced; subgenital opercule produced, spoon-shaped, margins approximating distad, apical margin with a very narrow, small, rectangulate emargination flanked laterad by very short and slender styles; cerci as long as the fifth abdominal segment, foliaceous, greatest width distad and regularly increasing in width in that direction, apex rotundato-truncate, visible segments fourteen in number, the terminal much longer as well as broader than the others. Cephalic limbs very slender; coxæ about half the length of the shaft of the pronotum, all margins supplied with spines of several sizes, all, however, short; femora somewhat arcuate, compressed, greatest depth at the proximal fourth and contained about six times in the length, discoidal spines placed at the greatest depth and three in number, lateral margin with seven regularly placed even sized spines, internal margin with fifteen spines of two alternating lengths, lateral and median genicular

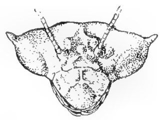

Fig. 6. *Toxodera pluto* n. sp. Cephalic view of head. (× 3.)

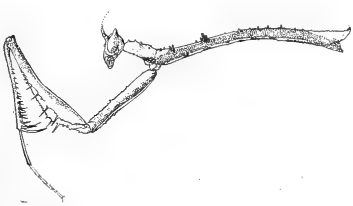

Fig. 7. *Toxodera pluto* n. sp. Lateral view of head, pronotum and cephalic limb. (Nat. size.)

[1] The lateral bases of the appendages project a considerable distance over the base of the fifth segment in this case, a condition much less marked in the case of the third segment.

lobes acute-angulate but not spiniform; cephalic tibiæ about four-fifths the length of the femora not including the apical tibial claw, very straight, slender, armed in the lateral margin with twelve to thirteen spines of several lengths, varying in length and agreeing on the two limbs, internal margin with twenty to twenty-one spines of several sizes, as a whole increasing in length distad; cephalic metatarsi contained about two and three-quarter times in the length of the femora. Median and caudal limbs subequal in size and very similar in form; femora with the two cephalic and the one caudal angle bearing foliaceous expansions, more extensive caudad than cephalad and with the margins eroso-crenulate, median genicular process elongate, acute spiniform, lateral genicular lobes with very long, mobile spurs, these appendages being arcuate and blunt; tibiæ extremely slender, sub-setiform, unspined except for the terminal calcaria which resemble the genicular spurs and are unequal in length; metatarsi slightly more than a third the length of the tibiæ.

General color buff, marked and washed with bistre. Head with the middle of the occiput, ocellar and inter-antennal regions dark, ocelli orange, eyes hazel. Pronotum with the sides of the shaft, dorsad and ventrad, except for the margins themselves dark, the margins pale with regular touches of dark, for a considerable distance cephalad the median carina is lined with pale and an elongate subtrigonal area on the caudal end of the shaft is of the same shade. Abdomen pale, the segments lined laterad and caudad with darker and the apex suffused with the same. Cephalic limbs washed with the darker color on the tibiæ, with very broad proximal and distal dark sections on the femora and shaded with the same on the dorso-lateral face and carina of the coxæ. Median and caudal femora with the distal section including that of lobes, darker, several "herring-bone" patterns of darker on the remaining pale sections; tibiæ and tarsi dark. Tegmina buff on the costal field, the principal veins lined with a broad irregular dark bar, the remainder hyaline with a few dark patches. Wings buff with a few dark spots along the costal margin, the remainder hyaline.

Measurements.

Length of body	86.5	mm.
Length pronotum	30.5	"
Length of tegmen	38.5	"
Length of cephalic femur	16.	"
Length of median femur	13.	"
Length of caudal femur	13.2	"

The type is the only specimen seen by the author.

Citharomantis[1] gen.

Allied to *Parairidopteryx* Saussure, but differing in the pronotum being longer than the cephalic coxæ, in the non-spinose pronotum, the moderate expansion of the cephalic femora and the emarginato-truncate apices of the ample wings.

Type.— *C. falcata* n. sp.

[1] **Κιθαρις** *a lyre*, in allusion to the shape of the closed wings.

Citharomantis falcata n. sp.

Type; ♂; Bah Soemboe, Sumatra. (R. Weber.)

Size small; form moderately elongate. Head distinctly broader than deep, occipital line nearly straight, indented by two sulci, a distinct spiniform process developed dorsad of the ocelli; facial scutellum transverse, the dorsal margin rectangulate, ventral margin subtruncate, the lateral portions narrow and the angle of the dorsal margin considerably projecting; ocelli rather large, slightly elevated; eyes considerably projecting, rounded, ovoid when viewed laterad; antennæ nearly as long as the tegmina, filiform. Pronotum half again as long as the greatest width of the head, greatest width (supra-coxal) about a third the distance from the cephalic margin; collar subequal in width, slightly longer than wide, cephalic margin evenly rounded; supra-coxal expansions sharply defined, rounded; shaft narrower than the collar except caudad where it is about subequal to the same, the narrowest portion being about in the middle of the pronotum; no median carina present but the collar is somewhat compressed within its margins; all margins unarmed. Tegmina about two and a half times the length of the pronotum, the greatest width contained about three and a half times in the length, regularly widening distad except for the reflexed costal field and the rounded apical section; costal field moderately broad at base, evenly emarginate mesad and distad; median vein with three distal rami, discoidal vein with two rami, all rather regularly disposed; costal field and apex of tegmina semi-coriaceous, remainder translucent. Wings extending a very short distance caudad of the closed tegmina the apex produced at the costal angle into a projecting bluntly falcate expansion, which when the wings are in repose gives the impression of a single emarginate, laterally expanded and rounded structure. Abdomen strongly depressed; subgenital plate rather broad, subtrigonal, the apex narrowly truncate and with a pair of very short styles; cerci short, rather slender, sub-fusiform. Cephalic coxæ about two-thirds as long as the pronotum, somewhat compressed, ventral carina with four to five proximal teeth; cephalic femora very slightly shorter than the pronotum, strongly compressed, the dorsal surface expanded in the proximal two-thirds into a lamellate crest, which at the deepest point is about half the greatest depth of the body of the femur; ventral margin obtuse-angulate, due to the greater median depth, discoidal spines four in number, lateral margin with five spines, one of which is on the base of the genicular lobe, internal margin with

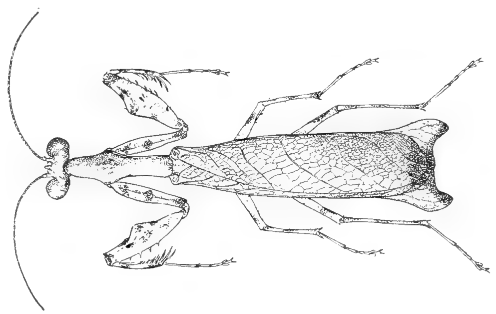

Fig. 8. *Citharomantis falcata* n. gen. and sp. Dorsal view of type. (× 2.)

Fig. 9. *Citharomantis falcata* n. gen. and sp. Lateral view of cephalic limb. (× 3.)

fourteen spines of several lengths, the distal one genicular in position; cephalic tibiæ, without claw, about half as long as the femora, armed on the lateral margin with twelve recumbent spines, on the internal margin with eleven more erect spines; cephalic metatarsi about four-fifths the tibial length. Median and caudal limbs moderately slender, the femora somewhat inflated; metatarsi of the median limbs slightly shorter than the remaining tarsal joints, of the caudal limbs very slightly longer than the other joints.

General color, pale apple green, where the same appears to have faded out it is represented by gamboge yellow. Head wood brown, mottled and speckled with vandyke brown, eyes of the same colors barred parallel with their length, antennæ pale proximad becoming darker mesad and distad. Pronotum with a distinct dark spot on the middle of the lateral face of the shaft. Tegmina greenish, more distinctly colored on the semi-coriaceous sections, several small faint brownish spots placed in the median portion of the discoidal field, the extreme apex bistre. Wings yellowish green on the semi-coriaceous apical section, distinctly margined with bistre caudad of the apex. Limbs wood brown, annulate and clouded with vandyke brown, the internal face of the cephalic limbs having these markings stronger and more apparent than in any other place, the cephalic coxæ internally with only the distal extremity dark.

Measurements.

Length of body	20.5 mm.
Length of pronotum	6.5 "
Length of tegmen	16. "
Length of cephalic femur	6.2 "

The type is the only specimen seen.

Phasmidæ.

Aschipasma annulipes *Westwood.* One individual, the sex of which is indeterminable as the apex of the abdomen is missing. In all probability it is a male. (R. W.)

Acrididæ.

Acrida nasuta *Linnæus.* Four females. (R. W.)

Eoscyllina[1] n. gen.

A member of the Scyllini and quite distinct from any of the known genera of the section. The differential characters are given in the detailed description below.

Type.— *E. inexpectata* n. sp.

[1] 'Ηως east, *Scyllina*, a generic name.

Eoscyllina inexpectata n. sp.

Type: ♀; Bah Soemboe, Sumatra. (R. Weber.)

Size rather small; form elongate, slender, slightly compressed. Head with the occiput slightly ascending; inter-ocular region slightly narrower than the fastigium; angle of the fastigium rectangulate, greatest fastigial width distinctly exceeding the length of the same, disk shallowly depressed within the margins; lateral foveolæ almost entirely visible from the dorsum, subrectangulate, nearly twice as long as wide, distinctly impressed; angle of the fastigium rather narrowly rounding into the face, which is distinctly retreating and slightly arcuate; frontal costa distinctly expanding from the apex to the insertion of the antennæ, very gradually expanding ventrad from the ocellus to the clypeal suture, shallowly and uniformly excavated with a short median carina dorsad; eyes acute ovoid, twice as long as the infra-ocular portion of the genæ; antennæ slightly longer than the head and pronotum, slightly flattened proximad. Pronotum with the greatest caudal width of the disk contained one and two fifths times in the length of the same; cephalic margin of disk subtruncate, caudal margin obtuse-angulate with the immediate apex rounded; lateral angles faintly carinate, very slightly diverging caudad on the prozona, more distinctly diverging on the metazona; median carina distinct, severed very slightly before the middle; lateral lobes about as long as deep, ventral margin obtuse-angulate, metazona cribroso-punctate. Interspace between the mesosternal lobes subquadrate; metasternal lobes attingent. Tegmina slender, extending caudad of the tips of the femora a distance about equal to the length of the pronotum, apex rounded, the whole apical portion very slightly curved toward the sutural margin; the intercalary vein is represented by an irregular substitute, which is sometimes broken and at no point possesses the strength or regularity of a true intercalary vein. Caudal femora nearly twice the length of the head and pronotum together, moderately inflated proximad, rather slender distad, pattern of the pagina distinct and regular; caudal tibiæ distinctly shorter than the femora, armed with ten spines in the external series, with eleven spines in the internal series, internal calcaria distinctly unequal, falcate.

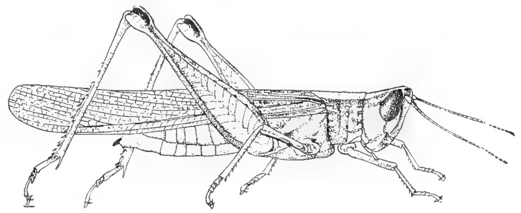

Fig. 10. *Eoscyllina inexpectata* n. gen. and sp. Lateral view of type. (× 2.)

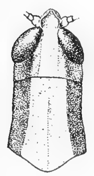

Fig. 11. *Eoscyllina inexpectata* n. gen. and sp. Dorsal view of head and pronotum. (× 3.)

General color russet on the head, dorsum of pronotum and caudal femora, becoming bistre on the distal portion of the tegmina. Head touched with mummy brown on the lateral portions; eyes burnt umber; antennæ mummy brown. Lateral lobes of the pronotum touched with dashes of bistre. Tegmina with the discoidal field as a whole darker than the costal and anal fields, a pattern of about six small quadrate pale spots present on the proximal portion of the same field. Caudal

femora with the pagina rather hoary, the genicular arches blackish and the ventral and internal face as well as the caudal tibiæ saturn red, spines with their apical halves black.

Measurements.

Length of body	21.	mm
Length of pronotum	4.	"
Greatest caudal width of pronotum	2.6	"
Length of tegmen	21.	"
Length of caudal femur	13.5	"

The type is unique.

Œdaleus marmoratus sundaicus *Saussure.* One male, two females. (R. W.)

This race has been recorded from Java, Sumatra and the Philippines.

Pternoscirta caliginosa (*Haan*). One male. (R. W.)

This specimen represents the small form of the species, as mentioned by Saussure. This species has been recorded from Malacca.

Heteropternis pyrrhoscelis (*Stål*). One male. (R. W.)

This widely distributed species occurs from Burma to China and northern Australia, Saussure having previously recorded it from Sumatra.

Trilophidia annulata (*Thunberg*). Two females. (R. W.)

Desmoptera sundaica n. sp.

Type: ♀; Sumatra. (Edwards Coll., Amer. Mus. Nat. Hist.)

Allied to *D. explicata* Karsch and *media* Bolivar, differing from both in the greater length of the tegmina and wings and in a number of color features. This is the first species of the genus recorded from outside the Moluccan and Papuan region.

Size moderately large; form distinctly compressed, venter flattened; surface irregularly granulose. Head, with the dorsum slightly less than two-thirds the

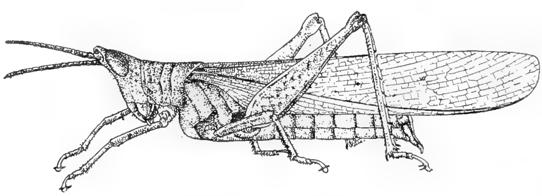

Fig. 12. *Desmoptera sundiaca* n. sp. Lateral view of type. (× 1½.)

length of the pronotum; occiput regularly and considerably ascending to the interocular region which is slightly more than half the greatest width of the fastigium; fastigial cleft indicated dorsad only by an impressed line for half the fastigial length, the margins of the fastigium being slightly converging to the obtuse-angulate apex, which has the margins of the fastigial cleft slightly protuberant, a broad rather shallow V-shaped impression with the apex directed forward is placed mesad on the

disk of the fastigium; fastigio-facial angle rostrate, shallow, the apical portion of the fastigium obliquely declivent when seen from the side, the immediate apex subtruncate, the facial portion of the apex slightly oblique; facial outline decidedly retreating, concave; frontal costa very narrow, very slightly and regularly expanding caudad, moderately sulcate; lateral facial carinæ moderately prominent, slightly diverging dorsad and ventrad, considerably diverging between the ventral portions of the eyes; eyes hardly prominent, moderately large, ovate in outline with a ventro-caudal truncation, slightly shorter than the infra-ocular portion of the genæ; antennæ very slightly shorter than the dorsal length of the head and pronotum, considerably depressed, very slightly expanded proximad, the apex short acute. Pronotum with the dorsum subarcuate in section cephalad, sub-deplanate caudad, greatest caudal width of the dorsum about two-thirds the length of the same; cephalic margin very slightly arcuate and supplied with small tubercles, caudal margin obtuse-angulate, the immediate apex subtruncate; transverse sulci three in number, the caudal one the more pronounced and straighter than the others, the metazona and prozona sub-equal in length; median carina hardly apparent, no lateral carinæ, the shoulder on the metazona not prominent; lateral lobes with their greatest dorsal length equal to their greatest caudal depth, the caudal margin of the lobes with the ventro-cephalic angle high, obtuse-angulate, the ventro-caudal angle slightly produced, obliquely subtruncate at the apex, ventral margin with its cephalic two thirds decidedly oblique-truncate, the caudal third slightly oblique. Tegmina appreciably more than twice the length of the caudal femora, exceeding the apex of the femora and of the abdomen by about the length of the head and pronotum, the greatest width contained five and one third times in the greatest length: costal lobe moderately large, the defining concavity of the same marked only on the proximal side, the costal margin straight thence to near the distal third where the margin slightly then rather abruptly rounds to the subtruncate apex, sutural margin nearly straight, the disto-sutural angle rectangulate. Prosternal projection transverse, supplied with a median transverse impression, the cephalic fold slightly more elevated than the caudal; interspace between the mesosternal lobes moderately transverse, slightly narrower caudad than cephalad; metasternal lobes widely separated, the lobes moderately arcuate, the interspace very shallow. Cephalic and median limbs slender, slightly elongate. Caudal femora falling slightly short of the apex of the abdomen, tapering, the proximal extremity subtruncate, margins well elevated, the pattern of the pagina irregularly diamond-shaped, genicular lobes moderately acute; caudal tibiæ slightly shorter than the femora, slender, straight, armed on the external and internal margins with nine spines; caudal tarsi slender, the first and third joints subequal.

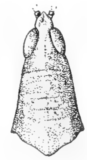

Fig. 13. *Desmoptera sundiaca* n. sp. Dorsal view of head and pronotum of type. (× 2).

General color uniform prout's brown, the abdomen and venter touched with tawny-olive, the tegmina with about a half a dozen scattered minute points of seal brown.

Measurements.

Length of body	30.5 mm.
Length of pronotum	6. "
Length of tegmen	30. "
Length of caudal femur	13.2 "

The type is the only specimen of the species seen by the author.

Oxyrrhepes lineatitarsis (*Stål*). One male. (R. W.)

This species has been recorded from Burma, Hong Kong and Java.

Quilta pulchra n. sp.

Type: ♀; Bah Soemboe, Sumatra. (R. Weber.)

Allied to the type species *Q. mitrata* Stål, from the Cocos or Keeling Islands, Indian Ocean, but differing in the smaller size, the rotundate cephalic margin of the pronotum, the obtuse-angulate caudo-lateral angles of the lateral lobes of the pronotum, the absence of paired dorsal spines on the apex of the caudal femora and in the rounded tips of the tegmina.

Size medium; form moderately elongate, slightly compressed; surface of the dorsum, the sides and the greater portion of the head strongly, but not very deeply,

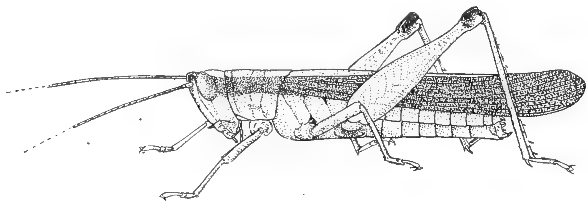

Fig. 14. *Quilta pulchra* n. sp. Lateral view of type. (× 2.)

punctate. Head with its dorsal length slightly more than half the length of the dorsum of the pronotum; occiput gently arcuate, not elevated dorsad of the disk of the pronotum, slightly descending to the interocular region which is equal to about half the greatest fastigial width; fastigium with its length about half again as long as its greatest width, sub-lanceolate, the sides gently arcuate, convergent, the immediate apex very narrowly truncate, the surface plane, the apex very slightly depressed when seen from the side; fastigio-facial angle acute-angulate, the immediate angle narrowly rounded, facial line considerably retreating: frontal costa subequal, sulcate; lateral facial carinæ slightly divergent ventrad; eyes ovate in outline, flattened ventro-cephalad, subequal in length to the infra-ocular portion of the genæ, slightly prominent when seen from the dorsum; antennæ nearly twice the length of the dorsum of the pronotum, filiform, apex, blunt. Pronotum with the greatest dorsal width contained one and two-thirds times in the length, cephalic margin moderately arcuate, caudal margin obtuse-angulate; median

Fig. 15. *Quilta pulchra* n. sp. Dorsal view of head and pronotum. (× 2.)

carina weakly indicated on the metazona, obsolete elsewhere, no lateral carinæ present, the shoulder of the metazona not prominent; prozona distinctly but not greatly exceeding the metazona in length, transverse sulci three in number, well impressed; lateral lobes very considerably longer than deep, the ventral margin considerably sinuato-emarginate cephalad. Tegmina slightly more than two and one half times the length of the head and pronotum, exceeding the apex of the abdomen by the length of the pronotum and the tips of the caudal femora by nearly the same distance, slender, subequal, the greatest width contained about seven and one half times in the length of the same; costal margin nearly straight, rounding in the distal fifth to the narrowly rounded apex, costal lobe hardly indicated; intercalary vein distinct, slightly irregular and ramose proximad. Prosternal spine conical, blunt, directed strongly caudad; interspace between the mesosternal lobes very slightly transverse, subequal in width to one of the lobes; metasternal lobes separated by a very narrow interspace. Ovipositor jaws short and thick, the apex and the margins strongly spinoso-dentate. Cephalic and median limbs of medium size. Caudal femora rather slender, about two and a half times the length of the dorsum of the pronotum, pattern of the pagina regular, rather shallowly impressed, genicular lobes acute spinose, dorsal portion of the genicular region unarmed; caudal tibiæ distinctly shorter than the femora, straight, the distal half expanded with the margins developed into lamellate ridges, external margin armed with eight spines one of which is apical, internal margin with eight spines; caudal tarsi not quite half the length of the tibiæ, the first and third joints subequal, the second quite short.

General color of the dorsum olive-yellow, of the sides, face, venter, cephalic and median limbs and caudal femora gamboge yellow, a broad postocular bar of bistre extending over the dorsal two-fifths of the lateral lobes and exposed dorsal edge of the pleura and suffusing all of the tegmina except the anal area. Eyes burnt umber; antennæ of the dorsal color infuscated distad; apex of the caudal femora seal brown edged with ochraceous-rufous the genicular spines tipped with black; caudal tibiæ pale glaucous washed with carmine at the genicular extremity, spines with more than their distal halves black.

Measurements.

Length of body	21.	mm.
Length of pronotum	4.7	"
Length of tegmen	20.	"
Length of caudal femur	12.	"

The type is unique.

Locusta consanguinea (*Serville*). Two males, one female. (R. W.)

These specimens all have the disk of the wings rose-color.

Locusta succincta (*Linnæus*). One male. (R. W.)

Coptacra cingulatipes *Bolivar*. Two males. (R. W.)

The types of this species were from Si-Rambé, Sumatra.

Traulia dimidiata (*Haan*). One male. (R. W.)

This species has been recorded from localities from Tenasserim to Amboina.

Traulia stigmatica *Bolivar*. One male. (R. W.)

This individual has been at some time immersed in a liquid preservative, and in consequence all the bright colors have been lost. The pattern is essentially as in Bolivar's description except that the reddish femoral maculation is not indicated.

Catantops humilis (*Serville*). One male, one female. (R. W.)

Tettigonidæ.

Elimæa rosea *Brunner*. One male. (R. W.)

This specimen may not be true *rosea,* which was described from Borneo, and in such a case would represent a new form allied to the Bornean species. The fastigium is distinctly sulcate, the supra-anal plate is thicker and hardly narrowly lanceolate as described in *rosea,* while the cerci are distinctly incurved. Until true *rosea* is available for study, I would, however, consider the specimen that species.

Exora dohrni *Brunner*. One female. (R. W.)

This specimen differs from the original description in some slight color characters, and in the tegmina being slightly narrower mesad and less truncate at the apex. The type locality is Deli, Sumatra.

Ducetia japonica (*Thunberg*). One male. (R. W.)

Elbenia nigro-signata *Stål*. One male. (R. W.)

This species, which was described from Malacca, is here recorded from Sumatra for the first time.

Arnobia pilipes (*Haan*). One male. (R. W.)

This species has been recorded from Japan and Malacca, and as the anal appendages of the male are unknown the following description may be of interest.

Cerci falciform, curved inwards, tapering in the proximal half, the distal half slightly flattened, the apex with a blunt tooth. Subgenital plate compressed, scoop-shaped, produced into a truncate process bearing very short and blunt lateral false styles, a distinct median carina present on the ventral surface; when seen from the side the distal portion of the subgenital plate is very slightly elevated, the dorsal line arcuato-concave, the ventral line obtuse-angulate.

Molpa emarginata (*Dohrn*). One male. (R. W.)

This is the first mention of the species since the original description,[1] where it was recorded from North Borneo and Deli, Sumatra. The subgenital plate is so deeply divided in this species that it might justly be said

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[1] Stett. Entom. Zeit., LIII, p. 68.

to have false styles, which would throw the genus into another section of the Phaneropterinæ according to Brunner's tables. The other two known species of the genus are from Ceylon and South India.

Holochlora javanica *Brunner*. One male. (R. W.)

The very peculiar anal appendages of this species are quite distinctive. In size this specimen is slightly smaller than the measurements given by Brunner.

Holochlora prasina n. sp.

Type: ♂; Bah Soemboe, Sumatra. (R. Weber.)

Allied to *H. signata* Brunner, from Borneo and Singapore, and *H. javanica*, but differing from the former in the divided anal segment and from the latter in the smaller size, more elongate tegmina, the non-produced anal segment, the slender and strongly incurved cerci and the longer styles of the subgenital plate.

Size medium; form slightly compressed; surface of the head polished except on the occiput, which, with the pronotum and pleura, is smooth but unpolished. Head with its dorsal length about two fifths that of the same portion of the pronotum; occiput gently arcuate, fastigium slightly projecting, compressed, slightly inflated proximad and with a very distinct longitudinal sulcus; facial fastigium not projecting, narrowly separated from the fastigium of the vertex; line of the face arcuate,

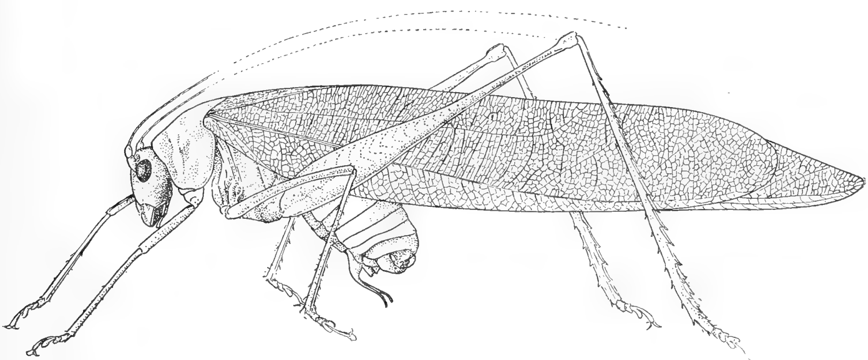

Fig. 16. *Holochlora prasina* n. sp. Lateral view of type. (× 2.)

somewhat retreating; eyes quite prominent, subovoid in basal outline, the length about equal to the depth of the infraocular area; antennæ reaching at least to the apex of the tegmina, proximal joint moderately inflated, appreciably constricted mesad on the internal face. Pronotum with the greatest dorsal width three-fourths the length, the dorsum nearly (cephalad and mesad) or quite (caudad) flat; cephalic margin slightly arcuato-emarginate, caudal margin strongly arcuate, lateral shoulders well rounded, particularly cephalad; middle of the disk with an impressed V, the apex directed caudad; lateral lobes considerably deeper than long, rounded ventrad,

the elytral sinus rectangulate, not very deep, a deeply impressed sinuate sulcus present caudad of the cephalic margin of the lateral lobes. Tegmina elongate lanceolate, about six and one-third times the length of the dorsum of the pronotum, the greatest width contained about four and two-thirds times in the length of the same; costal margin gently arcuate, sutural margin nearly straight except toward the apex where it is obliquely sub-truncate, the apex narrowly rounded; mediastine vein short, nearly straight, touching the costal margin at about the length of the dorsum of the pronotum from the base of the vein; median vein diverging from the discoidal very slightly before the middle of the same, bifurcate slightly before the middle, both rami reaching the caudal margin; anal area narrow, stridulating vein much thickened. Wings exceeding the apex of the tegmina by nearly the dorsal length of the pronotum, acute-angulate at the apex. Mesosternal lobes moderately produced with the apices sub-rectangulate; metasternal lobes low, rounded. Abdomen slightly depressed; anal segment transverse, mesad with a broad, moderately deep emargination, this being flanked laterad by narrow ridges separating the median excision from a pair of lateral ones, shallow and more rounded in character; cerci tapering and bearing setiferous papillæ in the proximal half, strongly recurved near the middle, the distal portion slender, arcuate, lying ventrad of the anal segment, somewhat depressed, the apex obliquely truncate and finely dentate; subgenital plate subtrigonal, strongly produced mesad into a pair of elongate styliform processes, each bearing a true style about one half their own length. Cephalic femora about equal to the dorsal length of the pronotum, bearing four spines on the ventro-cephalic margin, ventro-caudal margin unarmed; cephalic tibiæ distinctly longer than the femora, tympanum conchate cephalad, with a complete aperture caudad, the median and distal portion of the tibiæ slender, unarmed dorsad, with three spines on each ventral margin. Median femora in length slightly exceeding the depth of the tegmina, armed with several recumbent spines on the distal portion of each margin, median tibiæ slightly exceeding the femora in length, armed with from three to nine spines on the ventral margins, one to five on the dorso-caudal margin. Caudal femora about five eighths the length of the tegmina, considerably inflated proximad, genicular lobes spiniform, ventral margins with four to five spines distad; caudal tibiæ about equal to the femora in length, sinuate, margins strongly armed with recumbent spines, the ventral ones with fewer than the dorsal.

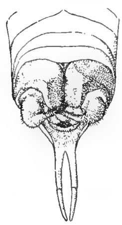

Fig. 17. *Holochlora prasina* n. sp. Dorsal view of apex of abdomen. (× 3.)

General color uniform pea green; eyes burnt umber; antennæ (except the proximal joint) and a narrow edging on the caudal margin of the dorsum of the pronotum ochraceous; a narrow dash at the base of the mediastine vein black; genicular regions of the cephalic and median limbs and the vicinity of the tympanum on the cephalic tibiæ lined with blackish brown; spines brownish tipped with blackish brown; median excision of the anal segment washed with brownish, cerci with their proximal halves clear brownish.

Measurements.

Length of body	21.	mm
Length of pronotum	5.8	"
Length of tegmen	38.2	"
Greatest width of tegmen	7.4	"
Length of caudal femur	23.	"

The type is the only specimen of the species which has been examined.

Sympaestria acute-lobata *Brunner.* Two females. (R. W.)

This species has been recorded previously from Borneo.

Phaneroptera subnotata *Stål.* One female. (R. W.)

Isopsera scalaris n. sp.

Type: ♀; Bah Soemboe, Sumatra. (R. Weber.)

Allied to *I. pedunculata* Brunner from Rangoon, Calcutta and Assam, but differing in the distinctly smaller size, the less rounded caudal margin of the lateral lobes of the pronotum, the more numerous transverse veins of the tegmina and the bent as well as curved ovipositor.

Size rather small; form decidedly compressed, surface of the body with a slight gloss. Head with its dorsal length slightly greater than half the dorsal length of the pronotum; occiput hardly arcuate, slightly descending to the fastigium, which latter is slightly compressed, blunt and with a decided longitudinal sulcus; facial fastigium touching the fastigium of the vertex; line of the face very gently arcuate, slightly retreating; eyes hardly prominent, ovate in outline, the greatest length of the same slightly exceeding that of the infra-ocular area; antennæ reaching to the tips of the wings, proximal joint slightly narrowed mesad. Pronotum with the greatest dorsal width nearly three fourths the greatest length of the same, the dorsum

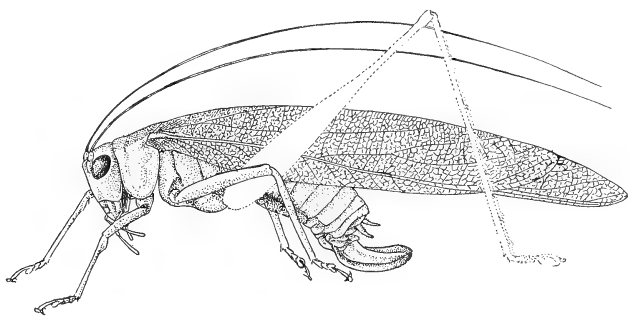

Fig. 18. *Isopsera scalaris* n. sp. Lateral view of type. (× 2.)

flat; cephalic margin very slightly concave, caudal margin strongly arcuate, lateral shoulders rather sharp, subparallel when seen from the dorsum; lateral lobes slightly longer than deep, ventral margin strongly rounded, the caudal margin obliquely sub-truncate, elytral sinus quite deep, acute-angulate. Tegmina rather elongate lanceolate, with the length about six and one half times that of the dorsal length of the pronotum and the greatest tegminal width contained four and one half times in the length of the same; costal and sutural margins gently arcuate, the apex rounded; median vein diverging slightly proximad of the middle, itself bifurcate proximad of its middle, the rami reaching the sutural margin. Wings exceeding the tips of the tegmina by about the length of the head and pronotum together, apex

produced acute-angulate. Mesosternal lobes slightly acute-angulate; metasternal lobes low, rounded, the caudal angle rounded rectangulate. Supra-anal plate trigonal, excavate; cerci rather short, styliform, slightly curved; ovipositor with its length in a straight line about equal to the dorsal length of the head and pronotum, moderately broad, bent arcuate, the apex slightly narrowed but decidedly blunt rotundate, dorsal margin crenulato-dentate for three fourths of its length, ventral margin with the distal fifth similar to the greater portion of the dorsal margin, remainder unarmed; subgenital plate acute trigonal, compressed, apex with a small but rather deep V-shaped emargination. Cephalic femora about as long as the dorsal length of the pronotum, ventro-cephalic margin armed with three spines distad, ventro-caudal margin unarmed; cephalic tibiæ half again as long as the femora, slender mesad and distad, unarmed on the dorsum except for a single apical spine, ventral margins each with four spines, tympanum with a complete aperture on each face. Median femora equal in length to that of the dorsum of the head and pronotum combined, the ventro-cephalic margin armed distad with three small dentiform spines, ventro-caudal margin unarmed; median tibiæ slightly longer than the femora, unarmed dorsad except for a single apical spine, ventral margins with six spines on the cephalic and four on the caudal side. Caudal limbs missing.

General color yellowish green (in all probability due to immersion in a liquid preservative); eyes vandyke brown.

Measurements.

Length of body	20.5	mm.
Length of pronotum	3.8	"
Length of tegmen	26.2	"
Length of ovipositor	5.2	"

The type is unique.

Mecopoda elongata (*Linnæus*). Seven males, six females. (R. W.)

The above series of this widely distributed and variable species presents the usual amount of individual variation in size and color. One specimen, a female, is extremely large, in several proportions exceeding the maximum measurements given by Redtenbacher.

Phyllomimus inversus *Brunner*. One female. (R. W.)

This individual has the purplish cast of the genicular region of the caudal femora mentioned by Brunner present on one limb and absent on the other.

Timanthes superbus n. sp.

Type: ♂; Benkoelen, Sumatra. (A. Schmiedell.)

Allied to *T. lobofolius* Haan and *latifolius* Brunner, but differing from the former in the larger size and the closely spinulose lateral margin of the caudal femora, as well as some details of the venation, and from the latter in the finely spined ventro-cephalic margin of the cephalic femora and in the tympanal field occupying but a third the length of the tegmina.

Size large; form robust, slightly compressed; surface of the head and limbs smooth, of the pronotum irregularly supplied with low tubercles. Head broad, short, the face quite flattened; fastigium produced, acute trigonal, the apex narrowly rounded, the dorsum of the fastigium faintly sulcate; eyes moderately prominent, subglobose; antennæ with the scrobes touching ventrad of the fastigium. Pronotum with the greatest dorsal length exceeding the greatest dorsal width by a third, dorsum of the pronotum arcuate in transverse section cephalad, deplanate caudad, cephalic margin of the dorsum gently arcuate, caudal margin rectangulate with the

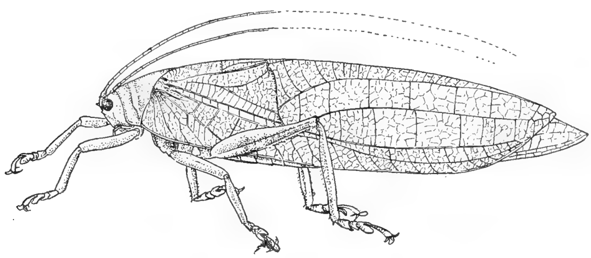

Fig. 19. *Timanthes superbus* n. sp. Lateral view of type. (Natural size.)

sides of the angle very slightly arcuate and the apex slightly rounded; rounded but distinct lateral shoulders present on the metazona; transverse sulci two in number, the cephalic straight on the dorsum, the caudal arcuate caudad, the metazona nearly twice the length of the prozona; lateral lobes slightly deeper than long, the cephalic margin moderately arcuato-emarginate, ventral margin arcuate, cephalic transverse sulcus strongly marked on the lateral lobes. Tegmina very large, inflated, in length three and one half times the length of the caudal femora, their greatest width slightly less than half the length, costal margin gently arcuate except for the distal third

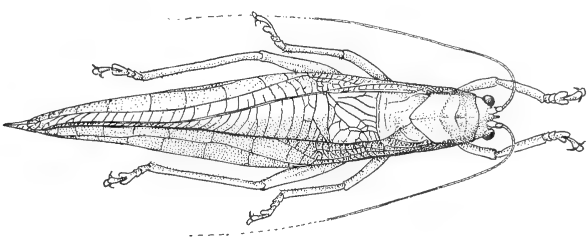

Fig. 20. *Timanthes superbus* n. sp. Dorsal view of type. (Nat. size.)

which is obliquely subtruncate rounding to the major portion of the costal margin, apex acute-angulate with the immediate apex narrowly rounded, sutural margin considerably arcuate proximad, very slightly arcuate mesad and distad; proximal lobe of the costal margin rounded sub-rectangulate; mediastine vein slightly sinuate, reaching the costal margin about a fourth of the length of the tegmina from the base; median vein reaching the costal margin very near the apex; anterior ulnar vein approaching very close to the discoidal proximad of the transverse fold; areas between the discoidal and median and median and anterior ulnar veins divided by straight

cross veins into quadrate areas; stridulating vein arcuate, the arcuation toward the apex. Wings exceeding the apex of the tegmina by about half the length of the pronotum, apex very acute-angulate. Mesosternum slightly transverse, the cephalo-lateral angles with rounded accessory lobes, foramina trigonal and separated by a space about equal to half the cephalic width of the mesosternum; metasternum narrowed caudad, foramina very closely placed and connected by an arcuate sulcus. Anal segment transverse, with a broad medio-longitudinal depression; supra-anal plate sub-lanceolate, apex obtuse-angulate with a shallow medio-longitudinal sulcus; cerci as long as the supra-anal plate, slightly arcuate, distal section narrowed chiefly by the more pronounced arcuation of the lateral margin, apex slightly rounded; subgenital plate broad, shallow, produced mesad into a bifurcate process, the stalk of which is quite slender and the arms appreciably depressed and sub-lamellate on the internal margin. Cephalic femora four fifths the length of the dorsum of the pronotum, the ventro-cephalic margin very weakly serrato-dentate; cephalic tibiæ equal to the femora in length, quadrate in section, dorsal margins unarmed, ventral margins with three spines on each, tympanum conchate on both sides. Median femora slightly longer than the cephalic, the external margin with from six to eight serrations, the internal margin with several small proximal serrations; median tibiæ about equal to the femora in length, dorsal margins unarmed, ventral margins spined. Caudal femora nearly twice the length of the dorsum of the pronotum, moderately inflated proximad, external face with a deep medio-longitudinal groove, external margin sub-lamellate, spinoso-dentate, internal margin with a number of smaller dentations; caudal tibiæ as long as the femora, slightly arcuate, moderately compressed, all the margins spined.

General color citron yellow, becoming buff on the limbs and ochre yellow on the greater portion of the pronotum. Eyes burnt umber; antennæ of the general color washed with reddish proximad.

Measurements.

Length of body	33.	mm.
Length of pronotum	9.	"
Length of tegmen	52.5	"
Greatest width of tegmen	21.5	"
Length of caudal femur	14.8	"

The type is unique.

Timanthes quadratus n. sp.

Type: ♀; Benkoelen, Sumatra. (A. Schmiedell.)

Allied to *T. lobifolius* but differing in the longer tegmina, shorter caudal limbs and regularly serrulate external margin of the caudal femora.

Size medium; form considerably compressed; surface without tubercles. Head distinctly depressed, the face markedly flattened, the facial line nearly parallel with the axis of the body; fastigium acutely produced, the apex hardly blunted, the whole apex of the fastigium having the margin distinctly elevated; interocular region broad, arcuate in transverse section; eyes slightly prominent, subglobose; antennæ with

the proximal joint quite large, slightly depressed, very slightly exceeding the apex of the fastigium. Pronotum with its dorsal length about one and one half times that of the head, the greatest dorsal width of the same being equal to four fifths of the length; cephalic margin arcuate, caudal margin rounded obtuse-angulate, no lateral shoulders present except for an indication near the caudal margin, dorsum of the pronotum arcuate in section except caudad where it is deplanate; median carina weakly indicated caudad, transverse sulci two in number, the cephalic very faint on the dorsum, metazona slightly longer than the prozona; lateral lobes with the ventro-cephalic angle obtuse, the ventral margin supplied with a row of low tubercles. Tegmina lanceolate, about twice the length of the body, the greatest width contained more than three times in the length; costal margin nearly straight in the proximal half, moderately arcuate distad, sutural margin straight the greater part of its length, gently arcuate near the apex, the latter rather narrowly rounded; proximal lobe of the costal margin rectangulate, the costal margin with a distinct thickening throughout its length, but stronger and more apparent proximad; mediastine vein similar in character to the short oblique apically bifurcate veins of the costal field; median vein diverging slightly proximad of the middle, reaching the costal margin very near

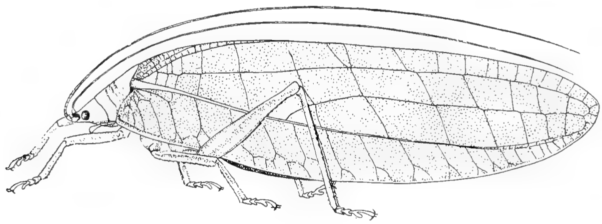

Fig. 21. *Timanthes quadratus* n. sp. Lateral view of type. (× 1½.)

the apex; anterior ulnar vein nearly straight, reaching the apex; cross veins in the areas between the discoidal and anterior ulnar veins regularly placed, oblique. Wings hardly surpassing the tips of the tegmina, acute at the apex. Mesosternum without marked accessory lobes, foramina moderately spaced; metasternum considerably narrowed caudad, foramina closely placed, connected by a strongly arcuate sulcus; ovipositor robust, in length nearly equal to the caudal femora, the greatest width about a third the length, apex acute, dorsal margin serrulate for over half its length, ventral margin very minutely serrulate for a third its length; subgenital plate very short, trigonal. Cephalic femora equal in length to the dorsum of the pronotum, ventral margins serrate; cephalic tibiæ slightly longer than the femora, dorso-caudal margin serrulate, dorso-cephalic margin entire, ventral margins with adpressed spines, tympanum strongly conchate on both faces. Median femora distinctly but not greatly longer than the cephalic femora, serrate on the ventral margins; median tibiæ slightly longer than the femora, compressed, strongly serrate on the dorso-caudal margin, dorso-cephalic margin entire, ventral margins with small adpressed spines. Caudal femora slightly less than a third the length of the tegmina, moderately robust in proportion to the length, tapering but little, ventral margins serrato-dentate; caudal tibiæ very slightly longer than the femora, compressed, dorso-cephalic margin entire, dorso-caudal margin distinctly serrate, ventro-cephalic margin slightly crenulate, ventro-caudal margin entire.

General color primrose yellow on the tegmina, becoming naples yellow on the head, pronotum and antennæ, the limbs cream buff. Eyes liver brown; costal thickening of the tegmina maize yellow; ovipositor ochraceous tipped with blackish.

Measurements.

Length of body	23.2 mm.
Length of pronotum	4.8 "
Length of tegmen	42. "
Greatest width of tegmen	13. "
Length of caudal femur	12.2 "
Length of ovipositor	12. "

The type alone has been examined.

Tympanoptera extraordinaria *Brunner.* One male, one female. (A. S.)

As the female of this species has never been described a few notes on this sex may be of interest.

Head and pronotum similar to those parts in the male. Tegmina elongate, sub-lanceolate, the length slightly over three times that of the caudal femora, greatest width contained three and one half times in the length; costal margin arcuate to the apex which is narrowly rounded, sutural margin straight; costal area broad, supplied with regular oblique bifurcate rami of the humeral vein with which rami the mediastine vein becomes lost; median vein escaping from the discoidal vein but a short distance from the apex; principal transverse veins of the discoidal field dividing it into five areas; anal field very narrow and elongate. General color olive-yellow, four irregular blotches of bright green, ringed in all but the distal one more or less completely with purplish, placed on the principal transverse veins of the discoidal field. Length of tegmen, 66.5 mm.

This species has been recorded from Borneo and Deli, Sumatra.

Aprion maculifolius *Pictet* & *Saussure.* Two females. (R. W.)

Cymatomera orientalis n. sp.

Type: ♂; Bah Soemboe, Sumatra. (R. Weber.)

Allied to *C. denticollis* Schaum from S. E. Africa and *C. pallidipes* Brunner from Loanda; differing from the former in the smaller size, the different tubercle arrangement of the pronotum and the different coloration; from the latter in the very different coloration, and possibly somewhat in structure as very few structural characters are mentioned in the original description.

This is the first species of the genus recorded from outside of Africa.

Size medium; form slightly depressed; head smooth, pronotum strongly tuberculate. Head broad, depressed, with the dorsal length about two thirds that of the pronotum; occiput slightly descending to the very broad interocular region; fasti-

gium of the vertex considerably and sharply produced, moderately tapering, the proximal width but slightly exceeding half the width of one of the eyes, apex slightly surpassing the antennal scrobes, narrow, divided, dorsum of the fastigium deplanate cephalad and there supplied with a slight medio-longitudinal sulcus; genæ somewhat inflated, bullate; face nearly horizontal, flattened; eyes of medium size, slightly exserted, globose but slightly depressed; antennæ with the scrobes large, the cephalic angle of the same sub-acute, the low facial fastigium separating the scrobes ventro-cephalad, proximal joint large, supplied with a rather prominent node on the internal portion of the distal margin. Pronotum with the dorsal length about half that of

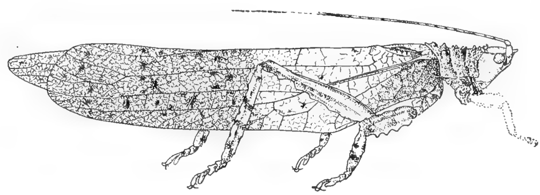

Fig. 22. *Cymatomera orientalis* n. sp. Dorsal view of type. (× 1½.)

the caudal femora, the greatest width (between the ventral margins of the lateral lobes) distinctly greater than the length; form of the pronotum distinctly sellate; cephalic margin of the dorsum obtuse-angulate with the apex of the angle truncate, caudal margin somewhat produced and moderately arcuate; median carina absent, transverse sulci two in number, broadly and deeply impressed; lateral carinæ indicated by a pair of rows of tubercles, which are quite close together at the cephalic transverse sulcus and from which they regularly diverge cephalad and caudad, the terminal tubercle cephalad and caudad being larger than the others; caudal margin of the disk without tubercles, cephalic margin with a median pair of fair size and a number of very small lateral ones, the median section of the disk of the pronotum

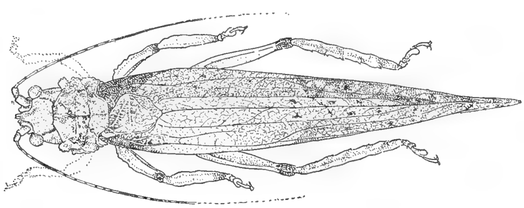

Fig. 23. *Cymatomera orientalis* n. sp. Dorsal view of type. (× 1½.)

has several groups of fair-sized tubercles in addition to those already mentioned; lateral lobes slightly longer than deep, considerably extended laterad, the greatest width there being about twice that on the dorsum of the metazona, ventral margin sinuato-truncate, the cephalic and caudal angle sub-rectangulate, transverse sulci distinct, surface with an arcuate transverse row of small tubercles. all the margins slightly tuberculate, elytral sinus arcuate, shallow. Tegmina of the peculiar texture and with the low nodes on some of the short cross veins seen in other species of the genus, in length about one and one half times the length of the body, the greatest width contained three and two thirds times in the length; costal margin regularly

arcuate in general outline, though closer view shows it to be decidedly crenulate, sutural margin straight except for the enlarged tambourine, apical portion obliquely rotundato-truncate; mediastine vein becoming lost in the cross veins of the costal area; median vein diverging distinctly proximad of the middle, continuing subparallel to the discoidal vein and reaching the apical margin; anterior ulnar vein with two subapical rami, the vein itself reaching the apical margin; tambourine with its greatest width equal to its length, stridulating vein not very heavy, nearly straight. Wings extending caudad of the tips of the closed tegmina by a distance about equal to three fourths the dorsal length of the pronotum, the apex rounded. Venter distinctly deplanate. Mesosternum strongly transverse, the cephalic margin arcuato-emarginate with the lateral angles broadly rounded, foramina widely separated, the connecting sulcus straight; metasternum transverse, the caudal margin arcuato-emarginate, foramina widely separated, connected by an arcuate sulcus. Anal segment strongly transverse, arcuato-emarginate mesad; supra-anal plate semi-elliptical, margin slightly elevated; cerci reaching nearly to the tips of the subgenital plate, straight, rather robust and tapering in the proximal two thirds, thickly beset with fine tubercles and long hairs, distal third hooked, though not abruptly so, slenderer than the proximal portions, the apex acute, the distal portion covered with much shorter hairs than the proximal; subgenital plate produced into a pair of depressed styliform processes separated by a very narrow and deep median incision, styles slightly longer than the styliform processes of the plate, slightly broader and more depressed proximad, apices blunt acute. Cephalic limbs missing. Median femora slightly longer than the dorsal length of the pronotum, very decidedly compressed and lamellate dorsad and ventrad, the dorsal margin irregularly serrato-dentate, the ventral margin with four distinct rounded lobes; median tibiæ about equal to the femora in length, inflated, compressed, the dorsal margin sinuate, the ventral ones with six to seven spines, the cephalic face with a marked longitudinal rounded sulcus. Caudal femora about twice the dorsal length of the pronotum, compressed, the dorsal margin sub-lamellate, regular, cephalo-ventral margin with two very low and three decided dentate lobes, genicular lobe on the cephalic face produced and rounded; caudal tibiæ very slightly shorter than the femora, moderately compressed, the dorsal margin slightly sinuate, the ventral ones nearly straight, with seven to eight spines; third joint of the tarsi strongly depressed and expanded, V-shaped.

General color wood brown, suffused with drab at the base of the costal field of the tegmina and in a lesser degree on the distal half of the whole tegmina. Nodes on the veins of the distal half of the tegmina vandyke brown. Eyes prout's brown; antennæ annulate with dark brown; median limbs irregularly spotted and the caudal tibiæ incompletely annulate with vandyke brown, genicular region of the caudal femora of the same color. Abdomen blackish brown dorsad.

Measurements.

Length of body	23.5 mm.
Length of pronotum	5. "
Length of tegmen	33.5 "
Length of caudal femur	11. "

The type is unique.

Tarphe novæ-hollandiæ (*Haan*). One male, one female. (R. W. and A. S.)

These specimens have the tegmina distinctly longer than the maximum measurements given by Brunner.

Pseudorhynchus calamus n. sp.

Type: ♀; Bah Soemboe, Sumatra. (R. Weber.)

Allied to *P. acuminatus* Redtenbacher from India, Burma, Java and Sumatra, but differing in the general smaller size and the greater length of the fastigium, tegmina and ovipositor.

Size medium; form decidedly elongate, very slender; surface rugulose. Head with its dorsal length distinctly greater than the dorsal length of the pronotum, acute produced, the fastigium slightly longer than the occiput and inter-ocular region, which latter have the dorsal outline horizontal when seen from the side;

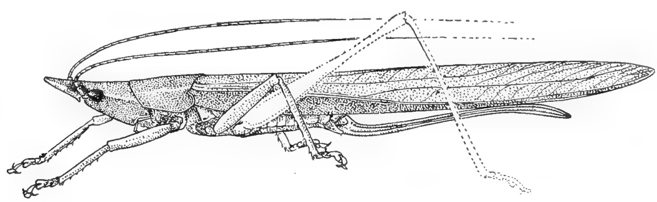

Fig. 24. *Pseudorhynchus calamus* n. sp. Lateral view of type. (× 1½.)

fastigium acute lanceolate, the greatest width slightly more than a third the length, the apex very narrowly blunted, the whole fastigium having an almost imperceptible dorsal trend, the ventral surface of the same with a distinct median ridge, proximal tooth short, blunt, not touching the face; facial outline very strongly retreating, being on the same angle as the ventral line of the fastigium; eyes rather small, not at all prominent, sub-pyriform in outline with the apex directed cephalad; antennæ moderately long. Pronotum with the greatest (caudal) dorsal width very slightly more than half the length, the dorsum strongly flattened; cephalic margin very slightly arcuate emarginate, caudal margin moderately arcuate, lateral angles well marked; single transverse sulcus crossing the dorsum of the pronotum hardly a third the length from the cephalic margin; lateral lobes about one and one half times as long as deep, ventro-cephalic angle very slightly angulate, ventral margin slightly arcuate, descending slightly caudad, ventro-caudal angle obtuse-angulate, caudal margin strongly arcuate with the tegminal emargination slightly less than a right angle, the extreme angle rounded. Tegmina about one and one half times the length of the body, elongate lanceolate, subequal, the greatest width contained nearly twelve times in the length; costal margin nearly straight in the proximal half, moderately arcuate in the distal half, sutural margin nearly straight, the apex acute; median vein diverging slightly proximad of the middle and bearing three rami; mediastine vein parallel to the humeral vein for nearly half the length of the latter.

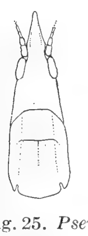

Fig. 25. *Pseudorhynchus calamus* n. sp. Dorsal outline of head and pronotum. (× 1½.)

Mesosternal and metasternal lobes produced, the angles rectangulate. Ovipositor about three times as long as the head and pronotum, slender, the distal two thirds slightly arcuate with the convexity dorsad, apex acute; subgenital plate subtrigonal, the apex narrowly arcuate emarginate, the plate with a medio-longitudinal keel. Cephalic femora very slightly shorter than the dorsum of the pronotum, the distal portion of the ventro-cephalic margin with one to three spines, the ventro-caudal margins unarmed, genicular lobes spiniform; cephalic tibiæ very slightly longer than the femora, tympanum compressed conchate on both sides, unarmed dorsad, the ventral margins with from six to seven spines. Median femora slightly longer than the cephalic, armed with two to three spines on the ventro-cephalic margin and with the ventro-caudal unarmed, genicular lobes spiniform; median tibiæ about as long as the femora the ventral margins with six to seven spines. Caudal limbs missing.

General color yellowish green (doubtless altered from a purer green by immersion in spirits), the distal half of the tegmina and the lateral lobes of the pronotum pale apple green, the ovipositor with its proximal two thirds weak ochraceous, the limbs inclining toward the same color. Eyes walnut brown.

Measurements.

Length of body	30.5	mm.
Length of pronotum	7.2	"
Length of fastigium	5.	"
Length of tegmen	46.	"
Length of ovipositor	23.5	"

The type only has been examined.

Conocephalus sobrinus *Bolivar.* One male. (R. W.)

This specimen has the fastigium slightly shorter than the measurements given by Redtenbacher (3.8 mm.), in this respect approaching *C. longiceps* Redt. from New Caledonia and *brachyxiphus* Redt. from Malaysia and China, but from both of these it differs in the longer tegmina. All three species seem to be very closely related.

Conocephalus saussurei *Redtenbacher.* Two females. (R. W.)

Agrœcia aberrans n. sp.

Type: ♀; Bah Soemboe, Sumatra. (R. Weber.)

Allied to the Australian *A. differens* Redtenbacher, but differing in the very much shorter tegmina, the lesser general size and the different spine formulæ of the femora. It agrees with *differens* in having both margins of the caudal femora spined, a character which separates these two forms from the other members of the genus.

Size rather small; form much as usual in the genus; surface of the pronotum obsoletely punctate, of the head, pleura and limbs smooth. Head with its exposed dorsal length about half that of the dorsum of the pronotum; occiput very slightly arcuate; fastigium slightly ascending, produced, slender, the apex abruptly truncate;

facial line distinctly retreating; eyes moderately prominent, very slightly compressed, crudely trigonal in basal outline; antennæ slightly over twice the length of the body, the scrobes with their rim moderately developed. Pronotum with the dorsal length about one and one half times the greatest caudal width of the disk; cephalic margin arcuate, subtruncate mesad, caudal margin arcuato-truncate, the lateral angles developed only on the caudal half of the metazona, broadly rounded cephalad and mesad; dorsum moderately arcuate in transverse section cephalad, deplanate caudad; transverse sulci strongly arcuate with the convexity caudad; lateral lobes with the greatest depth contained one and two thirds times in the greatest length, the greatest depth caudad, ventral margin oblique, the ventro-cephalic angle obtuse, the ventro-caudal margin broadly rounded, tegminal incision very shallow, subobsolete, the lobe with a distinct rounded depression extending some distance cephalad and ventrad of the incision. Tegmina slightly exceeding the apex of the abdomen, narrow, the greatest width proximad, tapering to the narrow apex which is oblique truncate; costal field tapering, widest proximad; median vein divergent distinctly distad of the middle. Wings reaching to the tips of the tegmina. Prosternum with a pair of very elongate, subparallel spines; mesosternal lobes slightly acute-angulate; metasternal lobes rectangulate. Cerci short, conic, acute;

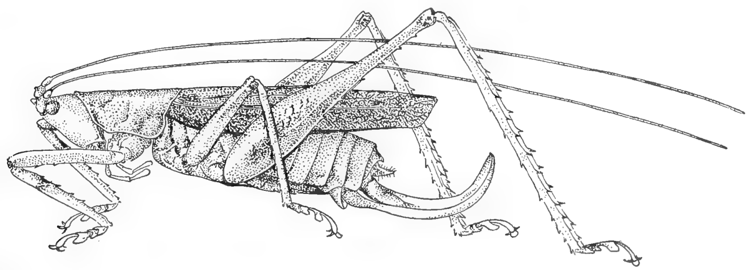

Fig. 26. *Agrœcia aberrans* n. sp. Lateral view of type. (× 2.)

ovipositor about half as long (measuring shortest distance) as the caudal femora, strongly falcate, apex acute, width moderate and nearly uniform except toward the apex; subgenital plate short, obtuse-angulate emarginate at the apex. Cephalic femora very slightly longer than the dorsum of the pronotum, armed on the ventro-cephalic margin with four spines, ventro-caudal margin armed with one spine in the distal third, cephalic genicular lobe acute, caudal genicular lobe rather rounded; cephalic tibiæ slightly longer than the femora, tympanum compressed conchate, dorsal margins unarmed, ventro-cephalic margin armed with eight spines, the ventro-caudal margin with six. Median femora about equal to the cephalic in length, the margins and genicular lobes similarly armed except that the ventro-caudal margin is not spined; median tibiæ slightly longer than the femora, the armament similar to that of the cephalic tibiæ except that the ventro-caudal margin has but five spines. Caudal femora about equal to the tegmina in length, considerably inflated proximad, quite slender distad, ventral margins armed with six to eight spines, genicular lobes spiniform; caudal tibiæ slightly longer than the caudal femora, all the margins supplied with spines, the ventral ones with a lesser number than the dorsal ones.

General color russet, the distal extremities of the femora, the tarsal joints, the tibial tympani and the mandibles marked with seal brown. Antennæ with widely

spaced narrow annuli of seal brown, the proximal antennal joint marked at the apex with the same. All the limbs more or less distinctly clouded with darker brown. Tegmina with a discal series of six or more small, irregularly shaped but rather regularly placed spots of seal brown, a clouding at the base of the costal field of the same color, the distal portion of the anal area being marked with a semi-elliptical spot of clear wood brown surrounded by seal brown. Eyes fawn color. Ovipositor ochraceous with the apex umber.

Measurements.

Length of body	23.	mm.
Length of pronotum	6.8	"
Length of tegmen	17.8	"
Length of caudal femur	18.	"
Length of ovipositor	10.5	"

The type is unique.

Macroxiphus sumatranus (*Haan*). One adult male, one immature male. (A. S.)

Xiphidion longipenne (*Haan*). Two males, two females. (R. W.)

Several of these specimens in some measurements, as the length of tegmina and of caudal femora, slightly exceed those given by Redtenbacher for this widely distributed species.

Hexacentrus unicolor *Serville.* One female. (R. W.)

Gryllacris podocausta *Haan.* One male. (R. W.)

This specimen is slightly larger than the measurements given by Brunner,[1] while the cephalic tibiæ are uniform blackish and the paler pronotal margin present only on the lateral and caudal margins.

Gryllacris amplipennis *Gerstaecker.* One male. (A. S.)

This individual belongs to the type described by Brunner [2] from Java and Madras Province.

Gryllacris borneensis subsp. **fruhstorferi** *Griffini.* One male. (A. S.)

This specimen agrees fully with the description of this recently described form,[3] which may be entitled to specific rank. The ventral margins of the caudal femora possess more numerous spine series than are present in the type, the external having seven to eight spines instead of five, the internal thirteen instead of eleven. As the type, from Deli, Sumatra, is a female, the measurements of the male may be of interest: length of body 32.5 mm.; length of pronotum 7.5; length of tegmen 54.5; length of caudal femur 20.5.

Gryllacris nigripennis *Gerstaecker.* Two males. (R. W. and A. S.)

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[1] Verh. K. K. Zool.-bot. Gesell. Wien, XXXVIII, p. 330.
[2] *Ibid.*, p. 336.
[3] Bollett. Mus. Zool. Anat. Comp., XXIII, N. 581, p. 13.

One of these individuals has the infuscation of the genicular regions and of the tarsi weaker than in the other. This species has previously been recorded from Malabar and Java.

Gryllacris fuscifrons *Gerstaecker*. Two males. (A. S.)

Gryllacris larvata n. sp.

Types; ♂ and ♀; Bah Soemboe, Sumatra. (R. Weber.)

Allied to *G. junius* Brunner, agreeing in the general form of the anal appendages, but differing in the somewhat greater size, the rather broader fastigium and in the depressed apex of the distinctly shorter appendage of the ninth dorsal abdominal segment.

Size rather large; form moderately robust. Head short, with the face decidedly flattened; occiput considerably arcuate, elevated very slightly dorsad of the disk

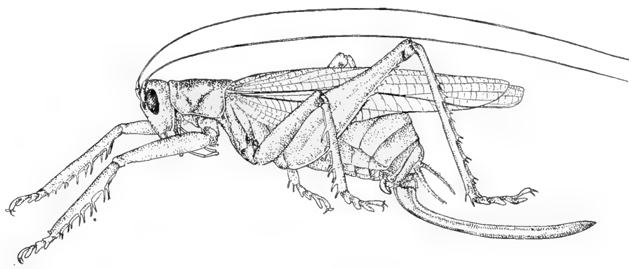

Fig. 27. *Gryllacris larvata* n. sp. Lateral view of female type. (Nat. size.)

of the pronotum, rounding over the interocular region and strongly descending to immediately dorsad of the suture between the fastigium of the vertex and that of the face; fastigium of the vertex about equal in width to one of the eyes; antennæ about twice as long as the body, the proximal joint of the antennæ of medium size, slightly depressed, obtuse-angulate on the internal face, scrobes very slightly elevated above the level of the face; eyes ovate in outline, hardly prominent, very slightly longer than the infra-ocular portion of the genæ. Pronotum with the greatest width distinctly but not greatly exceeding the length; cephalic margin slightly arcuate produced, caudal margin truncate, ventral margins of the lateral lobes slightly oblique truncate, ventro-cephalic angle obtuse-angulate, ventro-caudal angle obliquely truncate, elytral sinus very shallow; characteristic pronotal pattern moderately impressed. Tegmina slightly more than one and one-half times the length of the caudal femora, moderately broad, the apex narrowly rounded. Penultimate dorsal abdominal segment of the male inflated, sub-bullate, terminal dorsal

Fig. 28. *Gryllacris larvata* n. sp. Dorsal view of head and pronotum of male type. (Nat. size.)

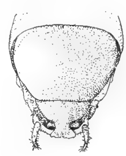

Fig. 29. *Gryllacris larvata* n. sp. Dorsal view of apex of male abdomen. (× 2.)

abdominal segment narrower proximad than the proximal width of the penultimate segment, the process not very long, constricted mesad, expanded distad, the apex arcuato-truncate and strongly depressed, the lateral angles slightly acute; cerci of the male broken; subgenital plate very broad, short, the apical margin obtuse-angulate, the apex with a shallow but broad obtuse-angulate emargination, styles lateral, simple, slightly curved, about equal to the greatest length of the plate. Cerci of the female moderately long, tapering, acute; ovipositor with its length slightly exceeding that of the caudal femora, regularly falciform, subequal in width except at the apex which is acute; subgenital plate of the female very broad proximad, produced mesad into a moderately long, narrowing, apically obtuse-angulate emarginate projection, the surface of the plate bearing a deeply marked Λ-shaped impressed figure, the apex of the impression directed toward the apex of the plate. Limbs moderately long, the articulate spines of the cephalic and median tibiæ particularly long; caudal femora moderately robust, stouter in the female than in the male, the lateral margin with nine to ten spines, the internal with ten to twelve [1]; caudal tibiæ equal to the femora in length, dorsal margins well spined, ventral face with a pair of distal spines.

General color of the head, antennæ, pronotum, limbs and abdomen ochraceous,[2] of the tegmina cinnamon-rufous. Head with the proximal and second joint of the antennæ, the antennal scrobes and the fastigium black, in the male areas caudad of the insertion of the antennæ and a cloud on the middle of the occiput of the same color; eyes ferruginous to liver brown. Pronotum with the greater portion of the dorsum blackish, the lateral portions and a pair of spots slightly caudad of the middle of the disk of the general color. Genicular regions of the femora clouded or washed with blackish brown; the tibiæ more or less completely suffused with seal brown, the suffusion being strongest on the cephalic tibiæ; movable spines of the cephalic and median tibiæ uniform ochraceous, femoral spines and fixed spines of the caudal tibiæ ochraceous tipped with blackish brown. Ovipositor burnt umber.

Measurements.

	♂	♀
Length of body	32.5 mm.	36.5 mm.
Length of pronotum	7.5 "	8.8 "
Length of tegmen	29. "	36.5 "
Length of caudal femur	20.5 "	22.5 "
Length of ovipositor		25.5 "

A paratypic female has been examined in addition to the types. It differs in no essential characters from the typical pair.

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[1] One caudal femur of the male types appears to be abnormal, having but five spines on each margin. The limb, while full size, exhibits other evidence of injury or partially arrested growth.

[2] The female type has the face and mouth parts red brown, but this appears to be due to discoloration or is an individual variation, as the paratypic female is colored as in the male type.

Family Gryllidæ.

Brachytrupes portentosus (*Lichtenstein*). Three males, one female. (R. W.)

Calyptotrypus helvolus (*Serville*). One male. (R. W.)

This species ranges from the Malay Peninsula to the Moluccas.

Crystallomorpha[1] n. gen.

A member of the division *Podoscirtites* of the Eneopterinæ, allied to *Hemiphonus* Saussure in having no speculum in the tambourine of the male tegmina. From the allied genus it can be separated by the short, broad head, very large eyes, the inflato-rimate tympanum on the cephalic face of the cephalic tibiæ, the much longer caudal metatarsi, the straight and uniramose oblique vein of the male tegmina and the non-ramose distal portion of the false discoidal vein in the same sex.

Head short and broad, deep; rostrum moderately protuberant; eyes large, considerably exserted. Pronotum broader than long, lateral lobes longer than the dorsum. Tegmina vitreous, equalling the apex of the abdomen, arcuate in section; mediastine vein ramose; stridulating vein rather weak; oblique vein uniramose; false discoidal vein without rami; distal portion of the dorsal field with a few sub-rectangular areas; no speculum present. Wings moderately caudate. Subgenital plate produced, moderately compressed. Cephalic tibiæ with the caudal face of the tympanum ovate, membraneous, cephalic face inflato-rimate. Caudal limbs very long; metatarsi quite long, the dorso-lateral margin with four to five spines, internal margin unarmed.

Type: — *C. sumatrensis* n. sp.

Crystallomorpha sumatrensis n. sp.

Type: ♂; Bah Soemboe, Sumatra. (R. Weber.)

Size rather small; form moderately elongate. Head broad and deep; occiput

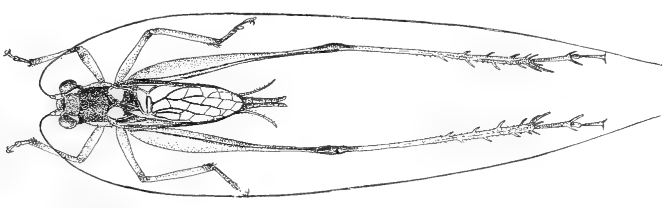

Fig. 30. *Crystallomorpha sumatrensis* n. gen. and sp. Dorsal view of type. (× 2.)

and inter-ocular region regularly descending to the rostrum, the space between the

[1] Κρυσταλλος *crystal*, μορφη *form*.

eyes equal to the width of one of the same; rostrum hardly protuberant, slightly depressed and sub-sulcate dorsad, rounded into the slightly retreating facial line ventrad; ocellus small, disposed in a compressed V-shaped figure, the ventral one placed between the centers of the proximal antennal joints where the same are in a vertical position; eyes very large, subglobose, slightly directed cephalad; antennæ at least three and one half times the length of the body, proximal joint rather broad and short. Pronotum slightly sellate, the disk broader than long; cephalic margin slightly arcuato-emarginate, caudal margin bisinuate emarginate, the surface of the disk clothed with adpressed white hairs; lateral lobes about as long as deep, but extending caudad of the dorsum of the pronotum, ventral margin very slightly arcuate, ventro-cephalic angle narrowly rounded, the caudal margin arcuate, the ventro-caudal angle well rounded. Tegmina about three fifths the length of the caudal femora, hyaline, apex well rounded, costal margin hardly arcuate in the greater portion of its length; mediastine vein with six rami; stridulating vein strongly arcuate mesad, but straight proximad and distad; axillary veins two in number; single oblique vein sinuate but its general direction is not strongly modified, possessing one ramus which is itself bifurcate; no speculum present. Wings

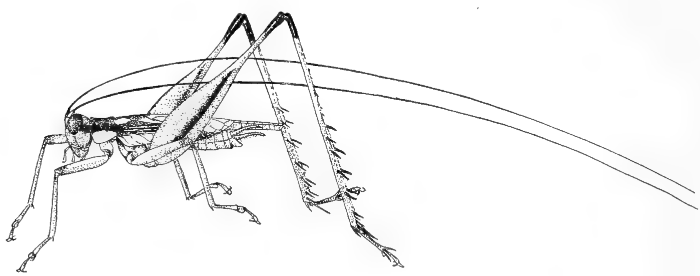

Fig. 31. *Crystallomorpha sumatrensis* n. gen and sp. Lateral view of type. (× 2.)

caudate, reaching caudad of the tips of the tegmina a distance equal to the tegminal dorsal width. Cerci tapering filiform distad, in length equal to the head and pronotum; subgenital plate moderately produced, compressed, the apex very narrowly subtruncate. Limbs slender. Cephalic tibiæ with the aperture on the cephalic face of the tympanum placed ventrad. Caudal femora considerably inflated proximad, quite slender distad, ventral margins unarmed, genicular lobes produced but the tips blunted; caudal tibiæ about equal to the femora in length, the dorsal margins with the serration spines rather large and distinctly spiniform, apical spurs on the internal face in length greatly exceeding those of the external face; caudal metatarsi elongate, slender, equal to the remainder of the tarsi in length, armed on the dorso-lateral margin with four to five spines, metatarsal spurs moderately long.

General color wood brown, the dorsum of the pronotum, the dorsal half of the lateral lobes of the same, genicular region of the caudal femora and tibiæ a broad line on the ventral portion of both faces of the caudal femora and a narrow dorsal line on the same blackish-brown. Tarsi and the distal extremity of the tibiæ blackish brown, the movable spines and spurs of the caudal tibiæ of the same color. Tegmina with a broad longitudinal bar at the angle of the two fields, a broad edging on the proximal third of the sutural margin and the principal veins of the dorsal field blackish brown; a pair of sub-circular spots of yellowish-white are placed one at the

end and the other at the bend of the stridulating veins, a much larger blotch of the same color being present at the base of the dorsal field. Abdomen with a fine lateral and a broader ventral blackish brown line. Head ochraceous with a subquadrate patch on the occiput, the apex of the rostrum and the two proximal antennal joints blackish-brown; eyes ferruginous; antennæ blackish brown with annuli of creamy-white on the proximal half, these narrower and closer proximad. Median and cephalic limbs slightly ferruginous.

Measurements.

Length of body	12.2 mm.
Length of pronotum	1.8 "
Length of tegmen	8.5 "
Length of caudal femur	14. "

A paratypic male has also been examined. It agrees fully with the type male except that the yellowish white spot at the bend of the stridulating vein is obsolete.

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Article XIV.— OBSERVATIONS ON THE HABITS OF THE FINBACK AND HUMPBACK WHALES OF THE EASTERN NORTH PACIFIC.

By Roy C. Andrews.

Plates XXX–XL.

During the spring and summer of the year 1908, the writer spent four months of study at the three shore-whaling stations now in operation on the west coast of North America. The first station, visited in May and June, is located at Sechart, Barclay Sound, on the west side of Vancouver Island, British Columbia. The month of July was spent at Kyuquot, one hundred miles north of Sechart on the same coast, and August at Tyee, on the southern end of Admiralty Island, Alaska.

At the Vancouver Island stations, Humpbacks, *Megaptera versabilis* Cope, Sulphurbottoms or Blue Whales, *Balænoptera sulfureus* (Cope) and Finbacks, *Balænoptera velifera* Cope, are taken in varying numbers, the first-named being by far the most numerous. Occasionally a Sperm Whale, *Physeter macrocephalus* Linn., is also captured. At Tyee, Alaska, where the hunting is chiefly done in the bays and sounds, Finbacks and Humpbacks are taken exclusively. No Sulphurbottoms have as yet been secured, since at this locality they apparently rarely leave the open sea to come into the inland waters.

At each station, some time was spent on board the vessels studying and photographing the living whales, and it is intended to embody in the present paper the results of these observations. So few Sulphurbottoms were seen during my stay on the whaling steamers that the notes upon this species will be reserved for a future publication, when it is hoped that additional material will be at hand.

I. Megaptera versabilis *Cope.*

The following observations were made at Vancouver Island and Alaska, the movements of the Humpbacks of the two localities being alike so far as I could determine.

Respiration. *Expiration.*— When coming to the surface the animal ascends *obliquely*, only the top of the head as far as the blowholes showing above the water. Instantly the spout is delivered. The cloud of vapor,

rising vertically, is narrow at the base, but spreads out at once forming a low, bushy column, rounded above, which rapidly disperses into a "puffy ball of spray." Fifteen feet is about the maximum height to which the spout of the *Megaptera* ascends, although Scammon says, "twenty feet or more." The height and density of the column, as in all whales, depends upon the time the animal has been below the surface, and the force with which the breath is expelled. If the period of submergence has been brief, the spout is usually thin, rising from eight to twelve feet into the air, and dissolving almost instantly. I have seen Humpbacks, which had been badly wounded, lying at the surface blowing every few seconds; the spout then could hardly be seen, although the opening and closing of the blowholes and the metallic whistling of the escaping breath were plainly distinguishable.

There seems to be some disagreement as to whether the *Megaptera* 'blow' in a single or double stream. Scammon says: "Like all other rorquals, it has two spiracles, and when it respires, the breath and vapor ejected through these apertures form the 'spout,' and rises in two separate columns, which, however, unite in one as they ascend and expand." [1] J. G. Millais accepts Scammon's view and adds that it "looks larger than that emitted by any of the other species of large Whale." His figures, however, show merely a single stream.[2] Packard, also, at second hand, records the blow of the Humpback as double, and "directed backwards toward the tail." [3]

From my own observations I cannot agree with these writers as to the divided character of the spout. I studied, with powerful field glasses, the expirations of a great number of Humpbacks, some of them only a short distance from the vessel, and could never distinguish a division of the vaporous column. Racovitza believes the spouts of both the *Megaptera* and *Balænoptera* to be single, citing his own and the opinions of other authors, as follows: "Baer (1864) déclare avoir vu que le souffle du *Balaenoptera* est simple et que d'ailleurs on ne pourrait le voir double qu'en regardant l'animal de face. Rawitz (1900) a vu aussi les souffles des Mégaptères, des *Balaenoptera musculus* et *physalus*, simples. Henking (1901) le figure aussi simple chez le *B. physalus*. Moi-même je l'ai toujours vu simple quoique des Mégaptères et das Balénoptères aient soufflé, très près de moi, de face et de profil."[4]

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[1] The Marine Mammals of the Northwestern Coast of North America, 1874, p. 42.

[2] The Mammals of Great Britain and Ireland, 1906, Vol. III, p. 239, plate facing p. 228, fig. 1, and plate facing p. 232.

[3] List of Vertebrates observed at Okak, Labrador, by Rev. Samuel Weiz, with Annotations. Proc. Boston Soc. Nat. Hist., 1866, Vol. X, p. 272.

[4] Résultats du Voyage du S. Y. Belgica, Zoologie, Cétacés, 1903, pp. 7, 8.

The drawing by Millais (*l. c.*, facing p. 228, fig. 1), is a fairly accurate delineation of the Humpback's spout, but it is quite unlike those shown on the plate facing p. 232, which are manifestly incorrect. Racovitza's figure (*l. c.*, p. 25, A), shows the spout directed more strongly backward than I believe would occur in a calm sea, unless the speed of the animal was great. As to the height he says, "s'élève dans les circonstances les plus favorables à une hauteur de 4 à 5 mètres" (*l. c.*, p. 25).

As noted by Racovitza and others, the expiration is accompanied by a loud, metallic whistling sound, which is undoubtedly produced by the rush of air through the blowholes. On a still day it can be heard for a considerable distance.

Inspiration.— Immediately after the delivery of the spout the inspiration occurs, and occupies from two to four seconds. This act is exceptionally well illustrated by the photograph (Plate XXX, Fig. 1) of a whale which rose to the surface partly under the vessel. The spout had just been delivered and the breath was being drawn forcibly into the lungs as the camera plate was exposed. It will be seen that the blowholes are greatly distended, forming a wide ellipse, and are protruded in a remarkable manner. In the excellent photograph of a spouting Sulphurbottom obtained by Glover M. Allen,[1] a great elevation of the outer eminences, which extend far above the apertures themselves, is shown. It would seem then, that the position of the blowholes is quite different during the two respiratory acts. In this connection Racovitza remarks: "L'orifice chez les Mystacocètes, au lieu d'être situé sur une proéminence conique comme pendant l'expiration, est maintenant largement béant, et la bosse de l'évent est tellement aplatie qu'elle se confond avec le contour régulier de la tête" (*l. c.*, p. 12). Racovitza's idea is thus just the reverse of what really happens. During expiration, as shown by Allen, it is not the blowholes themselves which are raised but the adjacent external eminences; and during inspiration, instead of being greatly flattened, the area surrounding the nasal apertures is distinctly elevated.

Millais speaks of the respiratory acts of the Humpbacks as follows: "If you watch any of the large Whales carefully at close range you will notice that the nostrils are only slightly opened during respiration, which lasts about five seconds. Immediately, however, the air is expended, they open wide for two seconds while the lungs are filled" (*l. c.*, pp. 239–240).

Number of Respirations.— The number of times the Humpbacks spout at each appearance is exceedingly variable; as a general rule, if the feed is

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[1] Some Observations on Rorquals off Southern Newfoundland. Amer. Naturalist, Vol. XXXVIII, No. 453, Sept., 1904, fig. 1.

far below the surface requiring a considerable period of submergence, the animals will blow six or seven times before descending, in order thoroughly to reoxygenate the blood. If, on the contrary, the dives are short, the intermediate respirations are usually few. However, I have seen individuals which were 'travelling,' or swimming long distances beneath the surface, rise to spout but once or twice and again descend. Scammon says that the Humpbacks will blow from one up to fifteen or twenty times, but this statement is, I think, somewhat exaggerated.

Diving.— The diving movements of the *Megaptera* are of two classes, viz: the 'sounding' or 'big dives,' when the animals descend to a considerable depth, and the short 'surface' or intermediate dives. The positions assumed during these actions are characteristic and quite distinct from each other.

Sounding.— Upon rising to the surface and delivering the spout, the Humpback depresses the head and begins to revolve. As the dive progresses the body is arched until it takes the form of an arc of a circle, the back slowly becoming visible. Finally, the dorsal fin appears and is soon prominently seen at the summit of the curvature. At this stage the animal has lifted itself high in the air and a greater portion of the body shows above the surface than at any other period during the dive. As the revolution continues, the flukes are drawn smoothly out of the water and elevated until the faces are at first parallel to the surface, then perpendicular to it. The whale is then in a *vertical* position, and remains so as the tail disappears.

These movements are illustrated by the photographs. Plate XXX, Fig. 2, and Plate XXXI, Fig. 1, show two Humpbacks in the act of sounding, the relative positions of the animals being about the same. In Plate XXXI, Fig. 2, the dive is slightly further advanced and the whale is exhibiting the maximum amount of the body above the surface. Plate XXXI, Fig. 3, is a posterior view of a sounding Humpback, *i. e.*, the animal is diving directly away from the vessel. The sharp ridge of the back posterior to the dorsal fin is shown, a breaking wave giving the effect of a patch of white upon it. In Plate XXXII, Fig. 1, the peduncle and flukes are exposed, the flat surfaces of the latter being horizontal to the water. The whale is *nearly* vertical in position. In the distance may be seen a second individual which has just spouted and is in the act of inspiring. The view is from behind. A small portion of the back is visible and the elevation of the blowholes is strikingly illustrated.

The next stage of the dive is shown in Plate XXXII, Fig. 2, where the flukes alone are seen, their flat surfaces being perpendicular to the water. The position of the animal at this time is vertical. The gradual disappearance of the tail is illustrated by Plate XXXIII, Figs. 1 and 2. Plate

XXXIII, Fig. 3, shows in profile two Humpbacks in the act of sounding; the flukes and 'small' of one are above the surface and the body of the other is at its greatest curvature.

Racovitza believes that the *Megaptera* rise obliquely and when sounding "l'animal descend obliquement mais dans une direction faisant un angle très aigu avec la verticale" (*l. c.*, p. 28). In confirmation of this view he gives a figure, drawn from a photograph, saying in explanation, "La direction du corps de l'animal est visiblement oblique. C'est donc obliquement qu'il plonge" (*l. c.*, p. 27, fig. 11). He does not, however, consider that the dive was not completed when his photograph was taken, and that in its further progress the body might reach the vertical position. This is what really happens, the animal descending directly downward. In regard to this point Rawitz remarks: "Fabricius (13) sagt, dass *Megaptera boops* schräg in die Tiefe herunter — und schräg aus ihr hevor tauche. Das letztere is richtig, das erstere nicht. *Boops* geht, wie man aus der später noch zu erwähnenden Stellung der Schwanzfinne erkennen kann, senkrecht in die Tiefe; *Musculus* dagegen geht in ziemlich schräger Stellung hinunter." [1]

Millais, also, says, "that it turns over and dives vertically there is no doubt" (*l. c.*, p. 40).

Intermediate Dives.— When the whale reappears after the big dive, several short or surface dives, of uncertain number and duration, are usually indulged in before it again sounds. The animal may swim just beneath the surface reappearing directly, or rise several hundred feet from the place where it descended. When going down for the intermediate dive, in most cases the back is but slightly arched, and there is comparatively little suggestion of the revolving motion so characteristic of the act of sounding. The movement is forward and somewhat downward, the anterior portion of the body gradually sinking lower until only the dorsal fin and the edge of the back directly posterior to it are above the water. Usually the tip of the dorsal is last to disappear. The flukes are never shown during this act. At times, during the intermediate dives, the *Megaptera* expose the whole of the back from the blowholes considerably beyond the dorsal fin.

The surface dives are well illustrated by the photographs. In Plate XXXIV, Fig. 1, the animal is in a typical position, the back being only slightly arched. This photograph and Plate XXXI, Fig. 1, are directly comparable and show well the great differences in attitude during the sounding and intermediate dives. In Plate XXXIV, Fig. 2, two Humpbacks are shown in the act of descending. The animal in the foreground

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[1] Ueber *Megaptera boops* Fabr., nebst Bemerkungen zur Biologie der Norwegischen Mystacoceten. Archiv für Naturgeschichte, 66 Jahrg. I, 1900, p. 96.

would soon have disappeared; the second whale has the back more strongly arched than is usual. A particularly interesting feature of this photograph is the beautiful illustration of the extreme types of variation in the dorsal fins of this species. I found, in the Pacific *Megaptera*, every gradation between the narrow, falcate fin, and its reduction to a low, rounded hump, as shown in the figure. Plate XXXIV, Fig. 3, is a photograph of a Humpback which was swimming at the surface with the whole dorsal region of the body, from the blowholes considerably beyond the fin, exposed.

Time beneath the surface and Distance traversed.— The periods of submergence are variable. When sounding, the animals remain below from five to twenty minutes; when taking the intermediate dives they may swim just beneath the surface, appearing every few seconds to spout, or be down for a number of minutes. If 'feed' is present the movements are undoubtedly controlled by the depth at which this is to be found.

The distance traversed by the *Megaptera* while below the surface depends entirely upon the conditions of the moment. When there is little feed and the whales are constantly moving or 'travelling,' they may rise a mile or more from the place of last appearance. If, on the contrary, feed is abundant, the animals may often spout within a short distance of the point at which they disappeared.

There is a belief, current among whalers, that the Cetaceans can remain under water for many hours without coming to the surface to respire. This owes its origin to the fact (which has been frequently observed) that whales will suddenly appear when for several hours previously there had been no sign of a spout, even at a distance. I believe this may be accounted for by the hypothesis, suggested by Racovitza, that both the *Megaptera* and *Balænoptera* frequently swim long distances at considerable speed without appearing to blow. Buchet [1] takes a contrary view, believing that whales sleep beneath the surface.

Both Humpbacks and Finbacks, when two or more individuals of the same species are associated, will frequently swim side by side in such proximity as to almost touch each other. When diving, they will leave the surface together and reappear at exactly the same instant. Millais has recorded something similar to this in the case of *B. musculus*: "Occasionally they turn under water and reappear half a mile astern of the vessel. It is difficult to understand how whales communicate with one another when they 'double' in this fashion, but on three occasions three Blue Whales turned simultaneously under water and came up half a mile astern of the vessel, and almost at the same spot" (*l. c.*, p. 255).

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[1] Quelques observations sur les Balénoptères des Eaux Islandaises. Bull. Soc. Zoolog. de France, Vol. XX, 1895, p. 30.

The Track.— A smooth, circular patch of water at the place of disappearance invariably accompanies the dive of both the *Megaptera* and *Balænoptera*. This is shown in Plate XXXII, Figs. 1 and 2. It is, I believe, a purely physical phenomenon produced by interrupted wave action and suction as the great animal descends. It is analogous to the disturbance caused by the sudden descent of any large body into the water.

The peculiar mirror-like appearance of the track has led Racovitza into error regarding its origin. Even though admitting the absence of sudoriporous and sebaceous glands in the skin of the Cetaceans, he nevertheless maintains that "il y a incontestablement une couche de graisse extrêmement mince, qui s'étend à la surface de l'eau et qui lui donne cet aspect bien connu de miroir" (*l. c.*, p. 15). In his endeavor to discover a satisfactory origin for the 'slick,' he evolves a theory which is at best improbable and ignores the possibility of explaining the phenomenon from a physical standpoint. He says: "Les observations suivantes pourront peut-être nous mettre sur la trace de la vérité.

"Thiercelin (1866 vol. I) à propos de la Baleine franche australe dit que....'du souffle....tombent quelques gouttelettes de matière grasse.' Si cette observation se vérifie, car on ne peut l'admettre sans hésitation, on aurait ainsi la source de la 'grasseur' mentionée, mais une autre observation que j'ai faite dans le détroit de Gerlache me paraît fournir une explication plus plausible. J'ai remarqué à la surface de l'eau, parmi les gros Balénoptères et Mégaptères du détroit, des masses informes de couleur rouge entourées de 'grasseurs.' C'étaient à ne pas en douter les excréments de ces animaux. Les Phoques et les Manchots avaient des excréments pareils, dont la couleur s'explique par la nourriture de ces animaux consistant en *Euphausia* abondamment pourvues de pigment rouge. Les *Euphausia*, comme tous les animaux planctoniques, possèdent de nombreuses gouttelettes graisseuses dans leurs tissus, gouttelettes qui doivent jouer le rôle de flotteurs chez les animaux passant leur vie entre deux eaux. Cela étant, les restes de la digestion des mammifères et oiseaux qui s'en nourrissent doivent contenir de la graisse. Il est donc possible que les grands Cétacés laissent suinter constamment par l'anus de petites quantités de matière grasse qui pouraient être l'origine des 'grasseurs' observées" (*l. c.*, p. 15).

The masses of red color which he observed may have been due to the excrement of the whales, or, what is quite as probable, to the presence at the surface of *Euphausia* themselves. It is highly improbable that excretory oil is constantly emitted by Cetaceans; and if so, that it would be of sufficient amount to cause a large slick at each disappearance of the animal beneath the water. Moreover, the excrement is forcibly ejected in a considerable quantity at one time, at least by the Finbacks, as I had an excellent

opportunity of observing. On August 19, while on board the steam whaler 'Tyee Jr.,' Capt. Chas. Grahame, hunting in the waters of Frederick Sound, Alaska, three Finbacks rose about one hundred and fifty feet from the vessel. They sounded immediately, and as the nearest whale went down a conspicuous brick-red patch, five or six feet in diameter, suddenly appeared at the surface and drifted directly under the bow of the vessel. I examined it with the greatest care and determined its identity as excrement beyond doubt. Capt. Grahame confirmed my opinion, saying that he had frequently observed the same occurrence. When whales are feeding near the surface, the presence of greasy matter might readily be accepted and has been recorded in the case of *B. physalus* by Millais, who says: "In the vicinity of the feeding operations the sea is suffused with a mass of oily matter, in which numerous small marine creatures, too small for the eye of man to see, are present" (*l. c.*, p. 268).

Play.— Numerous drawings have been published showing the *Megaptera* in the act of jumping or 'breaching,' but photographic evidence has hitherto been lacking. My notes give records of jumping Humpbacks for almost every day that I spent on board the whaling steamers. The animals always emerged from the water in a vertical position or very nearly so, frequently showing even the tips of the flukes, and invariably falling back upon the side. Plate XXXV, Fig. 1, is a photograph of a Humpback which had thrown itself entirely out of the water. The whale is shown breast forward and is falling upon its right side. The left pectoral limb is prominently displayed at an acute angle with the body; the caudal portion of the animal has already disappeared.

The figures of breaching Humpbacks given by Scammon (*l. c.*, pl. viii), Racovitza (*l. c.*, pl. iii, fig. 11 A and B) and Millais (*l. c.*, facing p. 232) seem to be correct; however, I have never seen the posterior part of the body held in the position shown in fig. B of Racovitza's drawing, which is duplicated by Millais. On July 8, and August 20, Humpbacks thrust the anterior half of the body into the air, fell sideways and sank back out of sight. An individual, on June 9, plunged along the surface, the head, chin and greater portion of the back out of water; the animal was in exactly the position figured by Racovitza (*l. c.*, pl. iii, fig. 12), excepting that the pectorals were not elevated as in his drawing. On June 9, a whale thrust the head to a considerable distance beyond the blowholes, obliquely out of the water. This again occurred twice in the case of another individual on August 21, when the photographs reproduced in Plate XXXV, Figs. 2 and 3, were taken. The mouth in Plate XXXV, Fig. 2, is seen to be widely open, the mandible being below the surface, and the outer edges of the baleen laminæ showing distinctly. In Fig. 3, the mouth is closed. At these appearances the spout was *not* delivered.

The *Megaptera* frequently assume an inverted position, having the peduncle and flukes out of the water, and thrashing the latter in every direction. This action has been figured by Scammon (*l. c.*, pl. viii) and designated as "lobtailing." I witnessed it on several occasions and obtained three pictures, Plate XXXVI, Figs. 1, 2 and 3, which, although hardly successful, are nevertheless of interest as being the first photographic records of the performance. In Fig. 3 the broad, superior surface of the right lobe of the flukes and the sharp, dorsal edge of the "small" may be seen. There was some variety in this action, at times the tail being waved rather slowly back and forth without touching the surface. Again the water would be lashed into foam, the spray almost concealing the thrashing flukes. On the morning of August 19, from the masthead, I saw in the distance numerous clouds of water thrown into the air. With field glasses I could plainly see that a school of Humpbacks were responsible for the disturbance. The animals were breaching, sometimes two at once. This continued for three minutes. How many individuals were taking part in the performance could not be determined.

Feeding.— When feeding, the *Megaptera* open the mouth and take in quantities of the floating *Euphausia*, then turn on the side and raise the under jaw, the water rushing out in streams from between the plates of baleen. One lobe of the flukes and, at times, one fin are thrust above the surface, a considerable portion of the body sometimes being exposed. Millais believes that the Humpbacks do not elevate the pectoral, differing in this respect from the Finbacks and Sulphurbottoms (*l. c.*, p. 239). This, however, is incorrect, for I have seen feeding Humpbacks thrust the fin straight upward as they rolled on the side. At other times this did not occur, and very little of the body was visible above the surface. Although Plate XXXV, Fig. 2, shows the mouth open, I do not believe the animal was feeding at the time; it was apparently indulging in play, and sank back out of sight without performing any of the motions which usually accompany the feeding operation. Rawitz (*l. c.*, p. 101) believes that in order to close the mouth the *Megaptera* throw themselves upon the back. This is too absurd to require comment.

Food.— When *Euphausia* are obtainable the west coast *Megaptera* apparently seldom eat anything else. I examined carefully the stomachs of all the whales which were brought in at the stations during my stay, and aside from a few worms (which unfortunately were not identified) nothing but *Euphausia* were found. Mr. Victor H. Street, Manager of the Tyee, Alaska, station, reported that one Humpback had been taken there which contained in its stomach a great quantity of codfish (probably *Gadus macrocephalus*), the largest being about sixteen inches in length. This is

the only authentic record which has reached me of fish having been eaten by Pacific Humpbacks.

II. Balænoptera velifera *Cope.*

The following observations were made during my stay on board the steam-whaler 'Tyee, Jr.,' Capt. Chas. Grahame, which hunts from the Tyee, Alaska, station.

Respiration. *Expiration.*— The Finback's spout contrasts so strikingly with that of the *Megaptera* that the two can never be confused, even when seen at a considerable distance. The column of vapor, under normal conditions, rises *vertically* to a height of from eighteen to twenty feet, and takes the shape of a narrow inverted cone, rounded superiorly. If no wind is blowing the vapor disperses slowly, drifting off in a club-shaped cloud; when dissolving it never assumes the spherical form so characteristic of the Humpback's spout. The photograph reproduced in Plate XXXVII, Fig. 1, gives an excellent idea of the Finback's spout. The view is lateral, and the column has risen to its full height. It will be noted that it is directed slightly forward, thus showing the effect of the light wind which was blowing at the time. The form assumed as the vapor drifts away is illustrated by Plate XXXVII, Fig. 2. This photograph is a posterior view; the animal's head is below the surface, and the dorsal fin may be seen just emerging from the water.

Plate XXXVII, Fig. 3, is of special interest. Two Finback whales are in the act of taking a surface dive, the dorsal fins and a small portion of the back alone being visible. However, an irregular spout is rising vertically from the water directly in front of the whale at the right. *Thus the animal is blowing after the head has again been submerged in the regular progress of the dive.* Considerable water would, of course, be thrown up in such a case, accounting for the reduced height and the irregularity of the spout.

The diagrammatic figures of the Finback's spout given by von Baer [1] and Henking,[2] have been commented upon by Racovitza (*l. c.*, p. 7), and Allen (*l. c.*, p. 613, 614), and will not be discussed here. The only published photograph of the spout of this species with which I am familiar is that presented by Millais (*l. c.*, facing p. 272). This picture shows two Finbacks in the act of blowing. The spout of the one at the right is rather indistinct, and that of the whale on the left has so evidently been 'improved' that it is

[1] Noch ein Wort über das Blasen der Cetaceen, mit bildlichen Darstellungen. Bull. de l'Acad. Imp. des Sci. de St. Pétersbourg, Vol. VII, 1864, p. 338.

[2] Über das Blasen der Wale. Zool. Anzeiger, Vol. XXIV, p. 105.

of little value. The stream of vapor is represented as rising vertically until the maximum height is reached, then, bending over, as descending almost to the water, parallel to the ascending column. It is not probable that even a strong wind could produce such a departure from the normal type of spout.

My observations agree with those of other writers that the Finbacks blow in a single stream. As to the height to which it ascends, estimates vary. Packard says, "about ten feet high" (*l. c.* p. 272); Millais gives "from ten to fifteen feet" (*l. c.*, p. 268); Allen (*l. c.*, p. 621) records twenty feet as a maximum spout for *B. musculus,* which he says he could not distinguish from that of *B. physalus.* This estimate I believe to be correct. As previously noted (*antea,* p. 214), the height is variable and depends upon circumstances.

Scammon has stated that the noise produced by the Finbacks during respiration is "quite distinguishable from that of other whales of the same genus" (*l. c.*, p. 35). As to the latter point I cannot say, but it is certainly sharper and very different from the respiratory sounds of the *Megaptera.*

Inspiration.— The inspiration is performed exactly as in the Humpbacks and, so far as I could determine, occupies about the same time — from two to four seconds.

Number of Respirations.— Ordinarily there seems to be more regularity as to the number of respirations between the periods of submergence than in the *Megaptera,* although this depends to a great extent upon circumstances. I found that the Finbacks usually blew about four times at fifteen second intervals before arching the back to sound.

Diving.— As in the case of the *Megaptera,* the positions assumed by the Finbacks during the sounding and surface dives are quite distinct.

Sounding.— The animals rise obliquely, exposing the top of the head to a point considerably beyond the blowholes, and deliver the spout. The head is then depressed, the inspiration completed and the anterior portion of the back becomes visible. As the dive progresses, the body is strongly arched and, when the dorsal fin appears at the summit of the curvature, the maximum amount of the animal is exposed above the surface. The body then gradually sinks until by the time the dorsal has again reached the water, it has disappeared.

Plate XXXVIII, Fig. 1, shows a Finback in the act of sounding. The attitude of this whale is typical, and very similar to that assumed by the Humpbacks, as will be seen by a comparison of Plate XXXI, Fig. 1, and Plate XXXVIII, Fig. 1. The flukes were never shown by the many individuals which I studied, my observations in this respect agreeing with those of Racovitza, Millais, True, Allen and other writers. Scammon, however, says: "In beginning the descent, it assumes a variety of positions: some-

times rolling over nearly on its side, at other times rounding, or perhaps heaving, its flukes out, and assuming nearly a perpendicular attitude" (*l. c.*, p. 35).

Intermediate Dives.— The movements of the surface dives are so similar to those of the Humpbacks that a detailed description is unnecessary. A comparison of Figs. 1 and 2, Plate XXXVIII, where the whales are in the same relative positions, gives an exact idea of the difference in appearance during the sounding and intermediate dive.

Millais says (*l. c.*, p. 267) that the animals roll over and show the eye when swimming near the surface, but this was never done by the Finbacks I observed. True also states (*l. c.*, p. 92) that the eye was not exposed by the Newfoundland specimens.

In Plate XXXVIII, Fig. 3, two Finbacks are shown during the short dive. The anterior portion of the back alone is exposed, the dorsal fins having not yet reached the surface. Plate XXXIX, Fig. 1, is of interest chiefly because it shows a peculiar depression or groove running longitudinally just beneath the ridge of the back. This may also be seen in the whale at the left in Plate XXXVIII, Fig. 3, and in the Humpback shown in Plate XXX, Fig. 2. Allen (*l. c.*, p. 618) has noted a similar groove just posterior to the blowholes in the case of a spouting Sulphurbottom. Thus it would seem that this depression extends the length of the back, nearly as far as the dorsal fin. Allen has suggested that it might be caused by the muscular contraction incident to the raising of the eminences about the blowholes when spouting; this hypothesis, however, is precluded, since my photographs show it to be present in whales which were not respiring. It may possibly be due to the action of the scapular muscles as the whale uses the flippers in descending.

Plate XXXIX, Fig. 2, is a posterior view of a Finback which has just been struck by the harpoon. An interesting feature of this photograph is the indication along the dorsal ridge of the neural spines of the vertebræ. The admirable photographs of Newfoundland Finbacks obtained by Dr. F. W. True give several stages of the dive not shown by my own figures.

Time beneath the surface and Distance traversed.— I have observed that the Finbacks, when feeding, often rise to respire with considerable regularity, but in general the time the animals will remain submerged is most uncertain. I timed the disappearance of several individuals. This is not always possible for, if a number are close together, one cannot be sure he is observing the same animal. The following table, however, was taken when the whales were either alone or sufficiently separated from the remainder of the school to make identification absolute.

A. 8 minutes and $5\frac{1}{2}$ minutes.
B. 7, 8, and 7 minutes.
C. 13, 5, 20, 4, 23, and 11 minutes (three individuals).
D. 5 and 6 minutes.
E. 8, $10\frac{1}{2}$, and 3 minutes.

The longest period of submergence was twenty-three, and the shortest three, minutes. Among the Atlantic Finbacks which he timed, Millais found the longest period to be fifteen, and the shortest four, minutes (*l. c.*, p. 268).

As in the *Megaptera*, the distance these whales swim while beneath the surface, and the direction of the course, is most uncertain, depending entirely upon circumstances.

Feeding.— When feeding, the Finbacks turn on the side, the water spouting from between the baleen laminæ as the mouth is closed. At this time the pectoral fin is erected and, with one lobe of the flukes, is prominently displayed above the surface. The animal frequently rolls from side to side exposing nearly the entire length of the body. Plate XL, Fig. 1, shows a Finback in the act of feeding, the fin and one lobe of the flukes alone being visible. A photograph of two feeding whales is reproduced in Plate XL, Fig. 2.

Food.— The stomachs of both the Vancouver Island and Alaska Finbacks contained only *Euphausia* with the exception of a single individual. This animal, taken on August 18, had eaten an enormous quantity of herrings (*Clupea pallasi*); four barrels (estimated) were taken from the stomach as well as a few *Euphausia*. Mr. Street stated that this was the first case of a Finback containing fish which had come under his notice.

Affection.— On August 20 a large female Finback, accompanied by her calf, was harpooned. The first iron failed to kill the animal, and while the gun was being reloaded, the calf remained by its wounded mother, swimming rapidly about her and showing the greatest concern. When the whale was finally dispatched by the second harpoon, the young Finback refused to leave the boat and was eventually killed. Plate XL, Fig. 3, shows the calf near its mother. The latter is fast to the vessel by the line, which may be seen in the lower left hand corner of the picture.

In conclusion the writer wishes to acknowledge his indebtedness to the Pacific Whaling Co., and Dr. L. Rissmuller of Victoria, B. C.; also to the Tyee Co., of Tyee, Admiralty Island, Alaska and Capt. I. N. Hibberd. By generously extending the privileges of their stations and vessels, these gentlemen made it possible to obtain the observations and photographs

which form the subject matter of the present paper. Thanks are also due to Messrs. J. Quinton, S. C. Ruck and V. H. Street, managers of the several stations; and to Captains Balcom, Larsen and Grahame, for the many courtesies received at their hands.

FIG. 1. HUMPBACK PARTLY UNDER VESSEL.

FIG. 2. HUMPBACK SOUNDING.

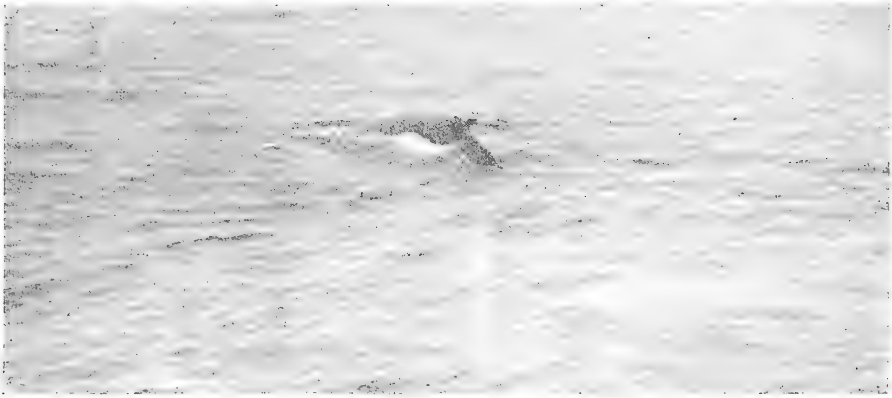

FIG. 1. HUMPBACK SOUNDING.

FIG. 2. HUMPBACK SHOWING MAXIMUM AMOUNT OF BODY.

FIG. 3. HUMPBACK SOUNDING: POSTERIOR VIEW.

FIG. 1. HUMPBACKS; BLOWHOLES (INSPIRATION), FLUKES, 'SLICK' (IN FOREGROUND).

FIG. 2. HUMPBACK, FLUKES PERPENDICULAR TO WATER.

FIG. 1. HUMPBACK, FLUKES DISAPPEARING.

FIG. 2. HUMPBACK, FLUKES DISAPPEARING.

FIG. 3. HUMPBACKS, SOUNDING (VIEW IN PROFILE).

Fig. 1. Humpback, taking surface dive.

Fig. 2. Two Humpbacks, taking surface dive.

Fig. 3. Humpback, showing a great portion of back.

FIG. 1. HUMPBACK 'BREACHING'.

FIG. 2. HUMPBACK WITH MOUTH OPEN.

FIG. 3. HUMPBACK MOUTH CLOSED.

FIG. 1.

FIG. 2.

FIG. 3.

FIGS. 1–3. HUMPBACKS 'LOBTAILING' — THRASHING THE WATER WITH FLUKES.

Fig. 1. Finback spouting.

Fig. 2. Finback's spout dissolving.

Fig. 3. Irregular spout of a Finback.

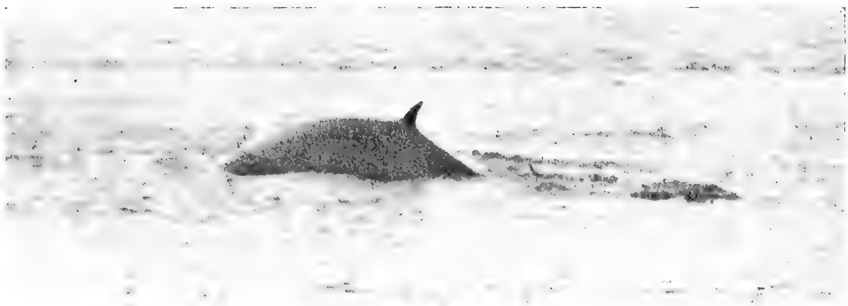

Fig. 1. Finback sounding.

Fig. 2. Finback taking surface dive.

Fig. 3. Two Finbacks taking surface dive.

Fig. 1. Finback showing depression on back.

Fig. 2. Finback struck by harpoon.

FIG. 1. FINBACK FEEDING, SHOWING FIN AND FLUKE.

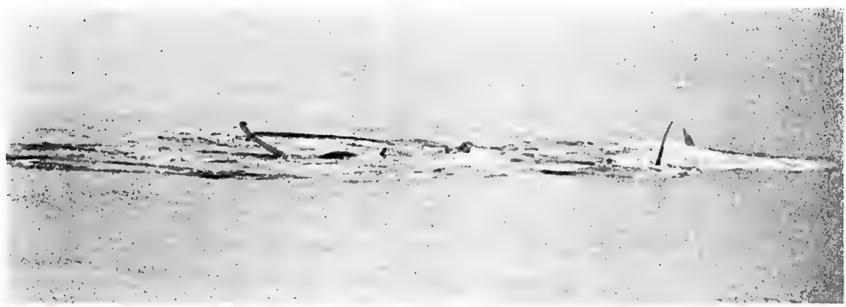

FIG. 2. TWO FINBACKS FEEDING.

FIG. 3. YOUNG FINBACK NEAR MOTHER.

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Article XV.— DESCRIPTIONS OF APPARENTLY A NEW SPECIES AND SUBSPECIES OF *CEBUS*, WITH REMARKS ON THE NOMENCLATURE OF LINNÆUS'S *SIMIA APELLA* AND *SIMIA CAPUCINA*.

By D. G. Elliot, D. Sc., F. R. S.

Before describing the apparently new forms, it will be advisable to consider the nomenclature of the two Linnæan species above named.

From the time when Humboldt described his species *Simia hypoleuca* (Recueil d'Observations de Zoologie et d'Anatomie Comparées, I, 1811, p. 337), great confusion has existed, both in the names and actual recognition of the species called by Linnæus *S. apella* and *S. capucina*. With many writers the first name has been ignored entirely, and Humboldt's name of *hypoleucus* has been universally applied to the black monkey with the forehead, sides of head, throat, chest, shoulders and forearms white, and ranging from Nicaragua through Central America, the islands in the Bay of Panama, and northern South America to Colombia. The name *capucinus* Linn., on the other hand, has been applied to the brown monkey (the most generally known of all the species), from northern South America, with the crown, hands, feet, forearms, line from crown between eyes and ears meeting under the chin, and tail black; underparts yellowish sometimes with a golden tinge. The species, however, is subject to an extreme individual variation, and, in consequence of this, has received many names from various writers.

Before proceeding further, it will be desirable to ascertain what really was the style of the animals on which Linnæus bestowed the names *apella* and *capucina*. These first appeared in his work entitled 'Museum Regis Adolphi Friderici,' published at Stockholm in 1754. Descriptions and plates are given of the two species in Latin and Swedish. The first mentioned is "*Simia apella*" with this diagnosis: "*Simia* imberbis, cauda prehensili, pedibus nigris, corpore fusco." The more extended description is as follows:

"Viva asservatur itidem in Museo. Corpus magnitudine Felis, colore fuscum, s. e. griseo nigricans uti Martes; at Pedes, & Cauda nigra. Caput supra nigrum, nigredine ad angulum frontis extensa. Facies incarnato-fusca, a superciliis ad mentum usque nuda. Supra supercilia facies quasi rasa pilis nuper renatis. Sub mento vellus breve, densum, atrum, pingue,

Aures rotundatæ, parvæ. Cauda longitudine corporis, basin versus crassior, pilis brevibus vestita, semper incurva, qua dum scandit, prehendit animal." The plate shows an uncolored figure of a monkey, with the distribution of colors indicated in black and white, answering to the above description, and is the species called by authors generally *Cebus capucinus* Linnæus. Then in the same work follows

"*Simia capucina*," with this diagnosis: "*Simia* imberbis nigra, cauda longa hirsuta, facie flavescente," followed beneath by the description: "Viva itidem in Museo occurrit. Corpus magnitudine cati, atrum pilo laxo longiusculo; at Facies & maxima pars capitis, excepto pileo nigro, pallide flava est una cum pectore ad flexuram usque cubitorum. Facies nuda est, parva & incarnata. Oculi nigri. Nares simæ, protuberantes quasi duobus tuberibus, hiantibus & patulis foraminibus, hinc fere befidæ, obtusissimæ; Basis narium inter oculos carinata est. Aures rotundæ pilosæ. Cauda corpore longior, valde hirsuta, & propemodum lanata, incurva, quam sæpius ante pectus vel supra scapulos inflectit." The figure in the plate exhibits a black monkey with a white head, except a black crown as stated above, white chest and forearms, shoulders and upper arms; a typical *hypoleucus* Humboldt.

By no possible interpretation of the above description and plate can the name *capucinus* Linn. be transferred from this black and white capuchin to the brown species called by Linnæus *apella*. Nor, indeed, would it have been probable that any confusion of names should have arisen, had it not have been, in a measure, caused by Linnæus himself, for in his 'Systema Naturæ,' 10th ed., 1758 (the one now generally agreed upon as the starting point for binomial nomenclature), in the diagnosis of *capucinus* he omits the word nigra after "S. caudata imberbis." But in the 12th ed., 1766, the one quoted to-day by many European naturalists as the beginning of the Linnæan nomenclature, Linnæus, as was not infrequently his habit, alters his original description of *capucinus* and makes his diagnosis read, "*S. caudata fuscus*" instead of *nigra*, and on the next page in his description gives "corpus fuscum, pedes, caudaque nigra, Pectus ferrugineum," which describes neither his *capucinus* nor *apella* as first given. In the edition of 1758, the only reference given to both species is the work "Museum Regis Adolphi Friderici," and in 1766 it is the only one for *apella* and the first one for *capucinus*, the other being Brisson's *Cercopithecus fuscus capite vertice nigro*, which is probably *apella* (*nec capucinus*) Linn. Here then is the commencement of the confusion existing for so long between the two species of Linnæus, for his *capucinus* of the 12th edition is not the *capucinus* of the 10th edition nor of the Mus. Reg. Adolp. Frider. No habitat was given at first for either species, but in the 10th edition *apella* is stated to come from

'America' and *capucinus* is still without a habitat; but in the 12th edition *capucinus* comes from Surinam, the other from 'America,' while the description of *capucinus* is a jumble of the two species, with a leaning towards *apella*. The confusion thus created by Linnæus himself has been noticed by previous authors, and some have increased it, like Dahlbom, who while correctly giving the name *capucinus* to the *hypoleucus* Humboldt, renamed the species from Guiana *pucherani*. Schlegel, in the Mus. Hist. Nat. Pays-Bas, Simiæ, in discussing the condition existing, p. 192, refuses to accept *capucinus* for the black and white monkey because Linnæus in his description gives 'corpus atrum,' which he says means "sombre, obscure, ténébreux" contrary to 'nigrum' which Linnæus employed to designate the cap on the head, and therefore he considers 'atrum' does not describe *hypoleucus* which has the body uniformly black. In this argument he ignores entirely Linnæus's original diagnosis of *capucinus,* which states "Simia imberbis nigra," and goes quite contrary to the Dictionaries, which define 'ater' as 'black,' 'coal-black'! Linnæus evidently uses niger and ater as synonymous, both defining the color of the body of *capucinus* as black, which it is. It will therefore be seen that Linnæus's *capucinus,* as originally described, was a black and white or yellowish white animal with a pale face, and not a brown monkey with a fuscous face (incarnato-fusca), and the name can only properly be applied to the species afterwards called *hypoleuca* by Humboldt, to which authors generally have erroneously given the name of *capucinus* (*nec* Linnæus).

We now come to the new allied form of *C. capucinus* (Linn.).

Cebus capucinus nigripectus subsp. nov.

Type locality. Las Pubas, Cauca Valley, Colombia. "Not found in lowlands" (Coll.).

Type, No. 14180, collection Amer. Mus. Nat. History, New York.

Color.— Sides of head and neck, chin, throat, shoulders and outer side of upper arms yellowish white; forehead bistre; top of head, back of neck, chest, body above and beneath, lower arms, legs, hands, feet and tail jet black.

Skull, compared with one of *C. capucinus* from Pozo Azul, Costa Rica, exhibits the following differences:— It is that of a young adult with the teeth but little worn, and part of palate, pterygoid and occipital region gone. The braincase is longer and 5 mm. less in the widest part, over the root of the zygoma; but is 16 mm. wider at the constriction behind orbits, which causes the sides of the braincase to be more nearly parallel; the orbits are smaller; the nasals much narrower; the palate (middle portion posteriorly from pm ^{2} gone) narrower, and contracting anteriorly; molar series much smaller, the last molar being about half the size of the middle molar, and appearing quite minute when compared with the other teeth in the series. Mandible has the ascending ramus much narrower, with a smaller and less wide angle; jaw at symphysis much narrower and not so deep. The mandible in fact is lighter,

generally smaller and shorter. There is not so much difference in the size of the lower molar series as there is in the upper, but the last molar is the smallest in the series, and smaller than the corresponding tooth in the Costa Rican *C. capucinus.*

Measurements.— Total length as given by the collector J. H. Batty, 835 mm.; tail, 430; hindfoot, 122; ear, 30. Skull, occipito-nasal length, 89; zygomatic width, 53.8; width of braincase above root of zygoma, 52; length of braincase from margin between orbits, 75; Hensel, about 68.5; skull broken; length of upper molar series, 32; width of last molar, 3.5; length of mandible on lower margin, 44.9; width at symphysis, 13.7; height of ascending ramus, 28.5; length of molar series, 25.9.

While resembling the typical *C. capucinus* (Linn.) in its general appearance it differs from that species in the color of the forehead which is bistre and not white nor yellowish white, and also in the white of the throat not extending on to the chest, which with the entire under parts is jet black like the other portions of the body. These differences with those given of the skull and particularly of the upper molars would seem to entitle this western form from the Cauca Valley to be ranked as a subspecies.

Three specimens were obtained, two young adults and one younger, all females. They are alike, the forehead of the youngest examples not being so dark as those of the adults. The collector remarks on the label, "Not found in lowlands, mountain species; sagacious, a shy animal, and expert jumper."

Cebus malitiosus sp. nov.

Cebus capucinus (nec Linn.) Allen, Bull. Am. Mus. Nat. Hist., 1904, p. 467.

Type locality: Vicinity of Bonda, Colombia, South America.

Type, No. 14620, collection American Museum of Natural History, New York.

Genl. char.— Mummy brown; shoulders yellow.

Color, Male.— Top of head, back of neck, entire upper parts, arms, including elbows and inner side of forearm and legs, mummy brown, tip of hairs paler, in some lights on the body of a golden hue; the crown is somewhat darker than the back; forehead wood brown; space around eyes naked, flesh color; end of nose and lips dark brown, the lips sparsely covered with short white hairs; face flesh color; sides of head, shoulders, forearms on outer side nearly to the elbow, straw yellow; body beneath and inner side of limbs similar to body above but paler; basal half of tail above mummy brown, apical half very dark wood brown; beneath buff color; hands and feet mummy brown; ears flesh color covered with straw yellow hairs.

Measurements.— Skin: Total length, 890 mm. (2 ft. 11 in.); tail, 433, ($17\frac{1}{4}$ in.); foot, 113 ($4\frac{1}{2}$ in.). Skull: occipito-nasal length, 98.2; Hensel, 77.5; postorbital constriction, 44; greatest width of braincase, 54.5; total length of skull, 102.3; zygomatic width, 70; palatal length, 35; length of nasals, 22.2; width of orbits, 47; length of molar series, 22.1; length of canines, 28.8; length of mandible, 60; height of ascending ramus, 34.6; width at alveolar border, 39.1; length of lower molar series, 37.7; length of canines, 26.6.

The above coloration is what seems to be the typical style, but there is

very great individual variation in the series present, some of the examples being a dark prout's brown, in some lights appearing blackish. The color of the tail varies greatly, and in some individuals the upper portion is mixed light and dark brown giving a grizzled appearance, while others have the basal half like the back, grading off to a wood brown on apical half. The color of the sides of neck and shoulders varies in depth, from a yellowish white to a golden yellow. There is no difference in the disposition of color between the sexes, nor in the brilliancy of tints, and such differences as are sometimes shown cannot be deemed sexual, but purely individual, each one doing apparently what seemeth best in his own eyes; but the hues are restricted to the dark and light shades of brown and yellow.

This species resembles none known to me. The coloring of the head recalls somewhat that of *C. albifrons*, but it has none of the red hue on the body of that species, nor has *C. albifrons* the yellow shoulders of this new form. It belongs to the group without tufts on the head, and differs in such a marked degree from all other species of that group with yellow on the shoulders or arms, that it is not necessary to compare them. The type belongs to the series collected by Herbert H. Smith, in Colombia, and which were provisionally referred to *C. capucinus* by Dr. Allen in his paper on the mammals from that State (*l. c.*).

I am indebted to my friend Dr. Allen for the opportunity of describing the new forms in this paper.

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Article XVI.— THE WHITE BEAR OF SOUTHWESTERN BRITISH COLUMBIA.

By J. A. Allen.

The Museum has recently secured two fine specimens of the Inland White Bear (*Ursus kermodei* Hornaday),[1] taken on Gribbel Island, B. C., the type locality of the species. They were killed between October 1 and 10, 1908, and are thus in excellent fall pelage. One is an old female, as unmistakably shown by the skin, with an imperfect skull, only the rostral portion, with the dentition, being preserved. The other is somewhat younger, though fully adult, and is apparently a male; the skull is nearly complete, lacking only part of the left zygomatic arch.

These specimens were obtained through the courtesy of Mr. F. Kermode, Curator of the Provincial Museum, Victoria, B. C., who has also kindly transmitted to the Museum, through Mr. Roy C. Andrews, Assistant in Mammalogy, a list of all the specimens of this bear known to him to have been captured during the last ten years, together with a map marked to show the localities of capture. He has also sent for examination the very imperfect skull of the type specimen, another complete skull, and the rostral portion of another. For these important favors grateful acknowledgments are hereby tendered.

These specimens differ considerably in color from the type of the species, which was described as "clear, creamy white, with no trace of brown, black or any other dark color," both having the whole top of the head yellowish rufous, with the back, in one of the specimens, conspicuously varied with bands and irregular patches of bright golden rufous. These specimens may be described as follows:

No. 34492, an old female. Whole top and sides of the head, from the front border of the eyes posteriorly, dark orange buff, the color where deepest extending to the roots of the pelage. The color of the top of the head extends along the nape to the shoulders as a fairly well defined median stripe, narrowing and fading posteriorly, and gradually blending with the general strongly yellowish white of the body. Over the mid-dorsal area the superficial yellowish white color deepens below the surface to orange buff and extends nearly to the roots of the hair. The vaginal tuft is bright yellowish rufous, of nearly the same shade as the top of the head. Limbs more strongly tinted than the body.

No. 34993, adult (probably male). In this the head is brighter and more ru-

[1] Ninth Ann. Rep. New York Zoöl. Soc. (for 1904), pp. 81–86, with 2 half-tone pll. Published January, 1905.

fous than in the other; the median band from the occiput extends to the middle of the back, darkening over and just behind the shoulders to deep rufous, in some lights almost chestnut rufous, and thence continues, but less distinctly defined, as far as the loins, lightening in tint to yellowish orange. There are also ill-defined longitudinal bands of yellowish orange on the sides of the body, which deepen in

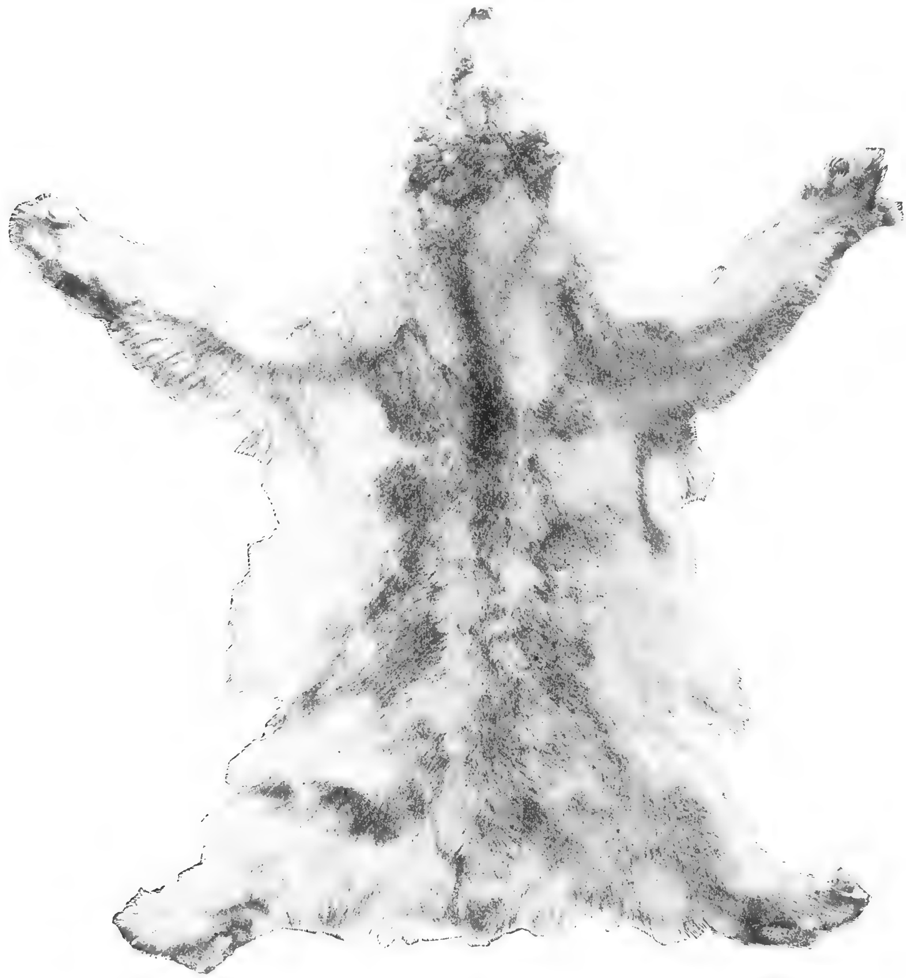

Fig. 1. *Ursus kermodei*, No. 34993, ♂ (?), Gribbel Island, British Columbia, October, 1908.

places to orange, forming a number of irregular patches. These markings are rather more distinct on the left side, where there are two of these lateral bands, than on the right. The general tendency of these bands is to form a pattern composed of three longitudinal stripes, the outer one on the right rather broad and not well defined, and on the left divided into two. (Fig. 1.)

The color of these specimens is hard to describe, as it varies with the angle of reflection of the light. For this reason when the skin of the female is placed crosswise to the light, the further half of the skin, in which the hair slopes from the light, looks creamy white, while the side toward the light, with the hairs directed toward it, is deep buff, a darker median space separating the two sides. When placed lengthwise, with the head towards the light and the hairs laid smooth, the whole dorsal surface, from the head posteriorly, is uniform deep creamy white, without any color pattern. When the male skin is placed crosswise to the light the ground color is nearly pure white, with the color pattern perfectly distinct, as it is also when the skin is placed lengthwise or crosswise to the light. With the head from the light, and looking at the skin from the side, the median line over the anterior half of the body is darker and richer, appearing dark orange rufous. Seen from in front looking towards the light the general color is much lighter but the markings remain perfectly distinct.[1] Where the markings are well developed the rufous color always extends to the base of the pelage.

In the male there is a very small tuft of blackish-tipped hairs on the median line behind the shoulders.

Ursus kermodei has always been described as clear creamy white to the roots of the hair. In the present specimens the color of the head is distinctly different from that of the body, and the basal portion of the pelage on the body is strongly suffused with buff, ranging in tint from pale buff to orange buff, and on some parts to orange rufous. The type and the other specimens in the mounted group in the Provincial Museum, Victoria, were taken in May; the present specimens, in October. It is, perhaps, reasonable to suppose that the buffy suffusion so conspicuous in October specimens may become somewhat faded later in the season; but the rich rufous tint of the head could hardly thus disappear.

So far as the pelage is concerned, these skins might readily be looked upon as albinistic examples of a normally dark-colored bear. The skull, however, presents distinctive characters of some importance, warranting the recognition, for the present at least, of *Ursus kermodei* as a strongly marked form, and possibly as a 'good species.'

The skull of the type was very imperfect (*cf.* Hornaday, *l. c.*), consisting of only a part of the rostrum and front part of the lower jaw, showing the dentition but not the general form of the skull. The teeth, as stated by Dr. Hornaday, "indicate relationship to the American Black Bear." In fact, the five specimens before me showing the dentition, present no tangible differences in the teeth from the Black Bear of the Kenai Peninsula, Alaska,

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[1] In taking the photograph shown in Fig. 1, the light was equalized from both sides.

Fig. 2. *Ursus kermodei*, No. 34993, ♂ (?), Gribbel Island, British Columbia. $\frac{4}{5}$ nat. size.

Fig. 3. *Ursus kermodei*, ♀. Gribbel Island, B. C. (Specimen in Provincial Museum, Victoria, B. C.) $\frac{4}{5}$ nat. size.

Fig. 4. *Ursus americanus*, No. 16707, ♀, Kenai Peninsula, Alaska. $\frac{4}{5}$ nat. size.

either in size or form. There is, however, a striking difference in the dorsal outline of the skull, which in Alaska specimens is nearly flat, but strongly convex in *U. kermodei*, the point of greatest height being at or slightly in front of the fronto-parietal suture, as shown in the accompanying illustrations (Figs. 2–4). The size of the skull in specimens from Alaska and Gribbel Island, strictly comparable as to age and sex, is nearly the same in both series, as shown in the subjoined table of measurements. So far as present material is available, *U. kermodei* is slightly smaller than the Alaska Black Bear, with a relatively narrower and longer skull, longer and narrower nasals, with the dorsal outline of the skull notably more convex. It differs from *U. carlottæ* in much smaller size, and in important cranial characters.

Measurements of Skulls.

	U. kermodei.			U. americanus.		
		34993[2]	34992[3]		17789[5]	16708[6]
	♀[1]	♂?	♀	♀	♂	
Total length	243	240	—	250	245	250
Condylobasal length	214	223	—	220	250	213
Palatal length	121	133	—	123	125	126
Zygomatic breadth	134	135	—	145	—	143
Interorbital breadth	53	56	—	61	54	51
Across postorbital processes	75	79	—	84	79	73
Mastoid breadth	100	113	—	113	—	108
Palatal breadth at m^1	36	39	—	40	35	38
Length of upper tooth row (including canine)	87	91	97	92	96	90
Length of p^4–m^2	52	54	52	51	57	49
Length of last molar	25	25	25	25	27	23.3
Greatest breadth of last molar at cingulum	13.5	15	13.2	13.5	15	13
Length of lower jaw (front border to condyle)	167	174	—	173	172	162
Height, angle to top of coronoid	64	72	—	69	69	61
Length of lower toothrow (including canine)	99	104	107	104	104	102
P^4 to m_3	51.5	61	55	58	60	56
Length of m_2	17	19	17.5	17	19	17.5
Greatest width of m_2	10	11	11	11	12	11.4

The known range of *Ursus kermodei*, as shown from the information kindly furnished by Mr. Kermode, extends from the lower part of South Bentinck Arm, Bella Coola River (lat. 52°), north to Nass Bay, at the head of Portland Inlet (lat. 55°), and from Aristazable, Princess Royal, Gribbel, and Pitt Islands, on the coast, to a considerable distance into the interior. Mr. Kermode's records are as follows:

[1] Gribbel Isl., Provincial Museum, Victoria, B. C., ♀.
[2] Gribbel Isl., Amer. Mus. No. 34993, ♂ (?).
[3] Gribbel Isl., Amer. Mus. No. 34992, ♀.
[4] Kenai Peninsula, Alaska, Amer. Mus. No. 16707, ♀.
[5] Kenai Peninsula, Alaska, Amer. Mus. No. 17789, ♂.
[6] Kenai Peninsula, Alaska, Amer. Mus. No. 16708, sex ?.

"Lindley and Foster of this city [Victoria] had two specimens in 1898 or 1899 from Gribbel Island; they were sold to some parties in England.

"Dr. W. T. Hornaday, of New York, bought one specimen from Boskowitz, a fur dealer in this city, in 1900, said to have come from Nass River.

"The type specimen, female, Provincial Museum, was killed on Gribbel Island in May, 1904.

"Two young cubs, male and female, in Provincial Museum, were killed at Kanoon River, Princess Royal Island, May, 1904.

"Another specimen, young male, Provincial Museum, was killed on Gribbel Island, May, 1906.

"Another specimen, Provincial Museum, killed on Gribbel Island, 27th May, 1907.

"The Rev. T. Collinson, of this city, also has one, that I have seen, said to have been killed on the Nass River about 1904.

"Mr. James Findley, of Vancouver, has another, that I have seen at his home, killed near his mine on Princess Royal Island, June, 1903.

"The two specimens recently sent by Mr. Lindley, of this city, to the American Museum of Natural History, New York, were killed on Gribbel Island between the 1st and 10th of October, 1908, as I had a letter from C. A. Robinson, Hartley Bay, on October 10, informing me of two that he had in his possession that had just been killed on Gribbel Island."

"There is still another specimen, not in fit condition for mounting, in the possession of Mr. Lindley, that was killed in the summer of 1908 .... up the coast, and must have been killed at this same locality ....

"In June, 1908, two friends of mine, P. Jacobson of Bella Coola, and C. A. Fields of this city, who were out timber cruising on South Bentinck Arm, saw one of these bears and were only thirty yards from it. I have seen both of them personally and both give the same account of it, so I believe it to be true.

"I have also heard from Dr. Holland, of the Carnegie Museum of Pittsburgh, that they have one in their Museum at the present time ....

"The late Robert Cunningham, a trader in furs, and who kept a large store at Port Essington for a great many years, told me that he had one or two of the white bears every year.

"Mr. George Robinson, missionary at Kitimat, who has lived in that vicinity for between sixteen and seventeen years, and traded with the Indians, says also that he has had some of these bears nearly every year. Mr. Robinson when in this city about two weeks ago [about Jan. 6, 1909,] left word that he has another in his possession killed this last fall."

Mr. Kermode refers further to two white bears seen last November on Pitt Island, and to two others killed in the mountains of Khutze Inlet in the fall of 1904; also to one killed on Swindle Island in 1902.

It is of interest to add that Mr. Kermode, in reply to inquiries as to the presence of other bears within the range of *U. kermodei*, states: "On the islands where the White Bear is found, Black Bears are also fairly common," and that "on the mainland Grizzly, Black, and the brown phase [of the Black] are found at the same localities as the white ones."

59.9(51.2:22)

Article XVII.— FURTHER NOTES ON MAMMALS FROM THE ISLAND OF HAINAN, CHINA.

By J. A. Allen.

Since the publication[1] of my former paper on a collection of mammals from the Island of Hainan, an additional lot has been received, consisting of 45 specimens of the larger mammals of the island, and adding two species (indicated in the subjoined list by an asterisk) to those previously listed, raising the total number to 43. Two subspecies are described as new. This additional material in no way duplicates that previously sent, inasmuch as it illustrates species before represented by one or two specimens or not at all.

The present material was all collected on Mount Wuchi or in its immediate vicinity, and contains fine series of *Macacus*, *Mungos* (= *Herpestes*), *Paguma*, *Viverricula*, *Helictis*, *Ratufa*, and *Lepus*. Several of the Hainan representatives of these genera evidently differ more or less strongly from the continental species to which they have previously been referred.

Evidently these two collections, both received through Mr. Owston of Yokohama, do not fully represent the mammalian fauna of the island, since of the Muridæ only a single specimen has been sent, and this was too immature for satisfactory identification.

1. **Cervulus muntjac** (*Zimmerman*). One specimen, a young female, Mt. Wuchi, Nov. 15, 1905.

2. **Lepus hainanus** *Swinhoe*. Eight specimens, Hoichow, Dec. 20; Notai, Dec. 20–25, 1905.

3. **Atherurus hainanus** *Allen*. One specimen, Notai, Dec. 28, 1905. This is a young female about half grown. It differs from the type markedly in coloration, being entirely pale rufous instead of blackish, apparently indicating that the species is dichromatic.

4. **Ratufa gigantea hainana** *Allen*. Four specimens, Mt. Wuchi, Nov. 1, 5, and 10, 1905. Very uniform in coloration, and they agree in every way with the type.

5. **Felis chinensis** *Gray*. Two specimens, an adult male, and a young (about one fourth grown) female, Mt. Wuchi, Oct. 15 and 25, 1905.

6. **Viverricula malaccensis** *Gmelin*. Four specimens, all adult: Mt. Wuchi, 3 specimens, Oct. 15, Nov. 1 and 2; Notai (one specimen without date).

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[1] Mammals from the Island of Hainan. This Bulletin, Vol. XXII, pp. 463–490, pl. lxix, Dec. 17, 1906.

7. * **Paradoxurus hermaphroditus** (*Pallas*). One specimen, about half grown, Mt. Wuchi, Nov. 18, 1905. First record for the island.

8. Paradoxurus (Paguma) larvatus hainanus subsp. nov.

Paguma larvata Allen (not of authors) Bull. Am. Mus. Nat. Hist., XXII, 1906, 479.

Type, No. 26599, ♀ ad., Cheteriang, Island of Hainan, China, Jan. 10, 1904.

Black and white markings as in *P. larvata*, but general coloration yellowish rufous instead of gray, as in the Chinese forms *Paguma larvata* (H. Smith) and *P. larvata taivana* Swinhoe. Size apparently about the same, judging by the skulls; external measurements are unavailable for comparison. Skull (type), occipito-nasal length, 107 mm.; condylobasal length,— (basioccipital region broken); palatal length, 51; length of nasals (lateral border), 21; zygomatic breadth, 58; interorbital, 20.5; postorbital, 21; mastoid, 37.5; upper toothrow (including canine), 36.

Represented by two specimens, the type (adult female) and a young male, the latter from Mt. Wuchi, Nov. 15, 1905. The type has the general color of the upper parts yellowish fulvous, darker and more rufous over the middle and hinder part of the back, lighter or more yellowish on the sides, passing rather gradually into the fulvous white of the ventral surface; extreme tip of tail white. The other specimen is much more strongly colored — deep rufous over the whole dorsal region, yellowish rufous on the sides, and fulvous gray below; tail wholly black apically.

The original description of *Paguma larvata* (= *Gulo larvatus* Ham. Smith, ex Temminck MS., Griffith's An. Kingd., II, 1827, p. 281 and plate) was based on a drawing of a specimen "in M. Temminck's celebrated museum [Amsterdam],. . . .named by him *Gulo Larvatus*, the Masked Glutton." No locality nor even country was indicated as being the home of the species. Four years later the species was redescribed by Gray (Proc. Zool. Soc. Lond., 1831, p. 95), from specimens brought from southern China by Reeves, and made the type of his genus *Paguma*. The *P. larvata* group appears to be restricted to southeastern China and the islands of Formosa and Hainan.

9. Mungos[1] rubrifrons sp. nov.

Herpestes griseus Allen (not of authors), Bull. Am. Mus. Nat. Hist., XXII, 1906, 479.

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[1] *Mungos* Geoffroy & Cuvier, Mag. Encyclop., II, 1795, pp. 184, 187. (*Cf.* Palmer, Index Gen. Mamm., 1904, p. 434.) Type, by tautonomy, *Viverra mungo* Gmelin. If *Viverra mungo* be considered as indeterminable, the type will be *Viverra ichneumon* Linn., the only other species originally referred to the genus *Mungos*. While *Galera* Browne (1756 and 1789) is an earlier name for the group usually known generically as *Herpestes* Illiger (1811), it is of doubtful tenability, dating properly from 1756 and not from 1789. (On the case of *Galera* see this Bulletin, XXIV, 1908, pp. 586–589.)

General color of upper parts, limbs and tail gray with a faint shade of olivaceous, in some specimens faintly fulvous, darker on the median line, lighter and more fulvous on the flanks; underfur at base blackish, apically fulvous; individual hairs of the dorsal pelage blackish with two narrow bands of pale yellowish white; ventral surface dull fulvous, some of the hairs annulated with dusky, and the dark brown underfur usually more or less visible at the surface; nose in front of the eyes blackish washed with ferruginous, black often prevailing; whole top of the head and nape nearly to the shoulders bright ferruginous punctated more or less with black; edge of the upper lip ferruginous, broadening and intensifying posteriorly so as to form a broad patch of chestnut extending back nearly to the ear; chin and throat with a strong tinge of rusty; in effect the whole head, except the ears and a lateral space in front of them, is bright ferruginous varied with black-tipped hairs; upper surface of fore and hind feet more or less strongly tinged with reddish; tail above like the back, edged with yellowish rusty; below with a broad median area of rufous, and a rufous fringe, the prevailing color of the apical third being also rufous.

A well made skin gives a total length of about 600 mm.; tail vertebræ, 240; hind foot (s. u.), 60. Skull (♂, type), occipitonasal length, 68; condylobasal, 64; palatal, 36; zygomatic breadth, 31; postorbital, 12.5; mastoid, 24; upper toothrow (including canine), 26. Five adults, including the type (1 ♂, 4 ♀): Occipitonasal length, 67.5 (65.5–69); condylobasal, 63 (61–64); palatal, 35.8 (35–37); zygomatic breadth, 32.4 (31–33.2); postorbital, 10.8 (9–12.5); mastoid, 23.8 (23–24.2); toothrow, 25 (24–26).

Represented by 8 specimens, 2 ♂, 6 ♀, all adult except two, some of them with worn teeth and five of them with strongly developed sagittal and occipital crests. In some the gray of the upper parts is more fulvous and the rufous of the head stronger than in others; the ventral surface is quite strongly reddish fulvous in some and fulvous gray in others.

This species is about the size of *Mungos griseus* (*M. mungo*), or slightly larger, from which it differs in the strongly rufous head, tail-edges, and feet. The skull averages about 4 mm. longer and 2 mm. wider than in Jamaica specimens of *M. griseus,* with well-marked differences in the form of the upper carnassial and first molar teeth. The difference in size between Jamaica and Hainan examples of *Mungos* are shown in the subjoined table.

The Hainan form of Mongoose belongs to the *M.* "*javanicus*" group, of the Malay Peninsula, of which it may be an insular representative.

Measurements of Skulls of Hainan and Jamaica Mongooses.

Hainan.

	Occipito-nasal length.	Condylo-basal length.	Palatal length.	Zygomatic breadth.	Postorb. breadth.	Mastoid breadth.	Upper tooth row.
27596 ♂	68	64	36	31	12.5	24	26
27595 ♀	69	64	37	33	11	24	25
27599 ♀	67	—	36	33.2	9	24	24
25997 ♀	65.6	61	35	32	11.5	23	25
25600 ♀	68	63	35	33	10.2	24.2	25
Average	67.5	63	35.8	32.4	10.8	23.8	25

Jamaica.

	Occipito-nasal length.	Condylo-basal length.	Palatal length.	Zygomatic breadth.	Postorb. breadth.	Mastoid breadth.	Upper tooth row.
10432 ♂	65	61	35	30	12	25	24.2
10431 ♂	60	60.5	35	32	12	24.4	23.2
10430 ♀	63	58	32.4	28	11.8	23	23
10433*a* ♀	62	57.5	34	30	11.5	22	23
10433 ♀	61.5	56	32.3	29.5	9	22	22.3
Average	63.6	58.6	33.8	29.7	11.3	23.3	23.1

10. * **Mungos urva** (*Hodgson*). One specimen, a very old female with the teeth greatly worn, Mt. Wuchi, Nov. 15, 1905. First record for the island.

11. **Helictis moschata** *Gray*. Two specimens, an old female and a half-grown male, Mt. Wuchi, Oct. 10, 1905.

12. **Crocidura (Pachyura) "murina"** *Auct.* Two specimens, adult females, Tingan, May 25, Notai, Dec. 28, 1905.

13. **Macacus rhesus** (*Audebert*). Ten specimens, Mt. Wuchi, Oct. 1–10, 1905. This is a fine series of well made skins with skulls, including adults of both sexes and two young specimens, one of them apparently about one month old and the other about three months old. The young closely resemble the adults in coloration, but are paler; the adults present a surprisingly small amount of individual color variation.

These specimens are tentatively referred to *Macacus rhesus*, in the absence of authentic examples of that species for comparison, but they probably represent an insular form of that or some nearly allied mainland species.

59.57, 92C.

Article XVIII.— THE SPECIES OF *BIORHIZA*, *PHILONIX* AND ALLIED GENERA, AND THEIR GALLS.

By William Beutenmüller.

Plates XLI–XLIII.

This paper constitutes the fifth installment of a series of papers on North American Cynipidæ and their galls which have been published by me in this volume of the Bulletin. The first being on *Rhodites*, the second on *Holcaspis*, the third on *Amphibolips* and the fourth on *Diastrophus*. The species of *Biorhiza*, *Philonix*, *Zopheroteras*, *Parateras* and *Xystoteras* are small ant-like creatures, and in general appearance resemble ants belonging to the genus *Cremastogaster* or *Dolichoderus*. They are known by the females only and possibly may be parthogenetic generations with rudimentary wings or wingless forms of some other bisexual and winged species belonging to other genera. *Philonix*, *Zopheroteras*, *Xystoteras* and *Parateras* are vaguely distinct from *Biorhiza*. A synoptic table of these genera was published by W. H. Ashmead in 'Psyche,' Vol. X, 1903, pages 148–150.

Biorhiza *Westwood.*

Biorhiza Westwood, Intro. Class. Ins., Vol. II, 1840, Synop., p. 56; Mayr, Gen. Gallenb. Cynip., 1881, p. 31; Cresson, Synop. Hymen. N. Am., 1887, p. 26; Ashmead, Psyche, Vol. X, 1903, p. 149.

Teras Hartig, Zeitsch. für Ent., Vol. II, 1840, p. 185; Mayr, Gen. Gallenb. Cynip., 1881, p. 31; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Apophyllus Hartig, Zeitsch. für Ent., Vol. II, 1840, p. 185; Mayr, Gen. Gallenb. Cynip., 1881, p. 31; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Biarhiza Fitch, 5th Rep. Nox. Ins. N. Y. Trans. N. Y. Agricul. Soc., 1858 (1859), p. 781.

Dryoteras Förster, Verh. zool.-bot. Gesell. Wien, Vol. XIX, 1869, p. 331; Mayr, Gen. Gallenb. Cynip., 1881, p. 31; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Biorrhiza Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 59; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Sphæroteras Ashmead, Psyche, Vol. VIII, 1897, p. 67; *ibid.* Vol. X, 1903, p. 150; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Xanthoteras Ashmead, Can. Ent., Vol. XXIX, 1897, p. 262; Psyche, Vol. X, 1903, p. 149; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Phylloteras Ashmead, Psyche, Vol. VIII, 1897, p. 67; *ibid.*, Vol. X, 1903, p. 149.

Female. Head with a ridge between the antennæ. Antennæ 14-jointed, stout, third joint longer than the fourth, joints seven to fourteen stouter than the second to sixth. Tarsi shorter than or as long as the tibiæ. Parapsidal grooves present. Scutellum rounded and without distinct foveæ. Claws with or without a tooth within.

Type: *Cynips aptera* Bosc.

Biorhiza forticornis (*Walsh*).

Cynips quercus ficus Fitch, 5th Rep. Nox. Ins. N. Y., Trans. N. Y. State Agricul. Soc., 1858 (1859), p. 782; Osten Sacken, Proc. Ent. Soc. Phila., Vol. I, 1861, p. 69; Glover, Ill. N. Am. Ent., 1878, pl. viii, fig. 15; Packard, Bull. 7, U. S. Ent. Com., 1881, p. 39; 5th Rep. U. S. Ent. Com., 1890, p. 111. (Gall only.)

Cynips q. ficus Osten Sacken, Ent. Zeit. Stettin, 1861, pp. 410, 413; Proc. Ent. Soc. Phila., Vol. II, 1863, p. 328; Walsh, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 489.

Cynips q. forticornis Walsh, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 490.

Cynips (Teras) forticornis Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 340, 350, 353.

Biorhiza forticornis Mayr, Gen. Gallenb. Cynip., 1881, p. 32; Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; *ibid.*, Vol. XIV, 1887, p. 132; Bull. 1, Col. Biol. Assoc., 1890, p. 38; Gillette, 27th Rep. Agricul. Mich., 1888, p. 470; Psyche, Vol. V, 1889, p. 186; Proc. Iowa Acad. Sci., Vol. I, pt. II, 1892, p. 113; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 259, pl. XIII, fig. 3; Am. Mus. Journ., Vol. IV, 1904, p. 105, fig. 36; Ins. Galls Vicin. N. Y., 1904, p. 19, fig. 36; Brodie, Ann. Rep. Forest, Ontario, 1896, p. 114, fig. 1; Bridwell, Trans. Kans. Acad. Sci., Vol. XVI, 1899, p. 203; Felt, 7th Rep. N. Y. Forest, Fish and Game, 1901, p. 530, pl. x, fig. 2; Ins. Affect. Park and Woodl. Trees, Vol. I, 1905, pl. 48, figs. 1, 2; *ibid.*, Vol. II, 1906, p. 626; Jarvis, 38th Rep. Ent. Soc. Ont., 1907 (1908), p. 90, pl. c. fig. 2; Fletcher, 38th Rep. Ent. Soc. Ont., 1907 (1908), p. 128.

Biorrhiza forticornis Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 60; Dalla Torre, and Kieffer, Gen. Ins. Hymen Fam. Cynip., 1902, p. 56.

Xanthoteras forticornis Ashmead, Can. Ent., Vol. XXIX, 1897, p. 262; Psyche, Vol. X, 1903, p. 149; Cook, 29th Rep. Dept. Geol. & Nat. Hist. Indiana, 1904 (1905), p. 833, fig. 26.

Female. Head rufous, scarcely polished, somewhat alutaceous. Eyes black. Antennæ stout, 14-jointed black or pitchy brown black. Thorax rufous, shining with the parapsidal groove deep and distinct, widely separated, converging at the scutellum. Scutellum shining, rounded, elevated, depressed at the base and with a few hairs. Pleuræ rufous, subopaque. Abdomen pitchy brown black, sometimes paler basally, compressed dorsally and ventrally, sides rounded. Ventral spine, hairy. Legs rufous, hind femora and tibiæ sometimes darker. Wings short, extending to about the second segment. Length 1.75 to 2.50 mm.

Gall. (Plate XLI, Figs. 1–7 and Plate XLII, Figs. 1, 2.) On the shoots of young white oaks (*Quercus alba*), dwarf chestnut oak (*Quercus prinoides*) and chestnut oak (*Quercus prinus*) in August to late in fall. Consists of many small, soft, thin shelled bladder-like bodies, each containing a single cell, which is held in position by many radiating fibers. They are closely pressed together and somewhat resemble figs packed in boxes,— hence the name "Fig Gall." Pale yellow, often beautifully tinged with red. Brown and brittle in winter.

Habitat. Canada; New England and Middle States westward to Colorado; Virginia; North Carolina.

Biorhiza mellea *Ashmead.*

Biorhiza mellea Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, pp. 138, 127.

Biorrhiza mellea Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 61; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Sphæroteras mellea Ashmead, Psyche, Vol. VIII, 1897, p. 67.

Female. Head dark honey yellow, finely punctate; eyes brown. Thorax dark honey yellow, smooth, shining with distinct parapsidal grooves. Scutellum dark honey yellow, rugose. Abdomen dark honey yellow, large, longer than the head and thorax combined, compressed and vertically as broad as long. Legs honey yellow. Wings rudimentary. Length 1.75–2 mm.

Gall. (Plate XLII, Figs. 3, 4.) On the upper side of the leaf of post oak (*Quercus minor*). Separately or in clusters of three or more. Small, globular and externally they are covered with minute warty pubescent dots. Internally they are fleshy and when matured are of a more or less cellular consistency and shrivel in drying. Attached by a slender point to the leaf and are easily detached. Diameter 2.50 to 3.75 mm.

Habitat. New Jersey (Lakehurst) ; Florida.

Biorhiza rubina *Gillette.*

Biorhiza rubinus Gillette, 27th Rep. Agricul. Mich., 1888, p. 472; Psyche, Vol. V, 1889, p. 215; Proc. Iowa Acad. Sci., 1887–89 (1890), p. 54; *ibid.*, Vol. I, pt. ii, 1892, p. 113.

Biorrhiza rubina Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 61.

Phylloteras rubinus Ashmead, Psyche, Vol. VIII, 1897, p. 67.

Trigonaspis rubina Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 55.

Female. Head black with shining hairs, clypeus with a number of rather stout hairs, a very few short hairs on the front border of epicranium and on the occiput, vertex bare. Antennæ brown-black, pubescent 13-jointed, reaching the middle of the abdomen, first and second joints nearly equal in length and rather stout, the first somewhat stouter than the second, third joint longest and most slender, fourth to twelfth gradually shortened, thirteenth one and a half as long as the twelfth. Thorax black, pubescent. Parapsidal grooves, shallow and indistinct, extending about one third of the way from the scutellum to the collar. Scutellum much rounded behind with two shallow foveæ at base. Abdomen smooth, glossy, black. Legs black with the joints yellowish brown, pubescent. Length 1.50 mm.

Gall. On the under sides of the leaves of white oak (*Quercus alba*) in autumn. Subglobular, juicy, and of a rosy color. Diameter 2 to 3 mm.

Habitat. New York ; Iowa; Michigan.

This species is not known to me; the single type female is with Prof. C. P. Gillette.

Biorhiza nigra *Fitch.*

Biarhiza nigra FITCH, 5th Rep. Nox. Ins. N. Y., (Trans. N. Y. Agricul. Soc., 1858 (1859), p. 782).

Biorhiza nigra OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. IV, 1865, p. 353; ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; *ibid.*, Vol. XIV, 1887, p. 132; Proc. Ent. Soc. Wash., Vol. III, 1895, p. 262.

Biorrhiza nigra DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 61; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Xystoteras nigra ASHMEAD, Smith. Cat. Ins. N. J., 1890, p. 548.

Female. Black throughout, including the feet and antennæ. Head broader than the thorax, and appearing twice as broad as long when viewed from above. Antennæ 14-jointed, thread-like and as long as the body. Abdomen strongly compressed, and broad when viewed in profile; the sutures marked by fine impressed transverse lines, and the first segment very large, about equal in length to all the remaining segments. The abdomen is much more smooth and shining than the thorax and head, which are bearded with minute gray hairs. Wings wanting. Length 2 mm.

Habitat: New York (Albany).

This species is unknown in collections and I do not seem to recognize it from the description. The type is lost.

Philonix *Fitch.*

Philonix, FITCH, 5th Rep. Nox. Ins. N. Y. (Trans. N. Y. Agricul. Soc., 1858 (1859), p. 782); ASHMEAD, Cat. Ins. N. J. (Smith), 1900, p. 548; Psyche, Vol. X, 1903, p. 148.

Acraspis MAYR, Gen. Gallenb. Cynip., 1881, p. 29; CRESSON, Syn. Hymen. N. Am., 1887, pp. 26, 28; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Female. Wings rudimentary or absent. Head large, genæ with or without a very fine furrow. Antennæ 14-jointed, filiform, long, third joint longest, following joints gradually decreasing in length. Head behind the eyes broadened. Pronotum very narrow in the middle, very broad laterally. Mesonotum with or without parapsidal grooves, when present these do not extend to the anterior margin. Scutellum triangular, terminating in a blunt point posteriorly, foveæ at base wanting. Metanotum short. Abdomen large compressed laterally or globose, smooth or pubescent. Ventral spine with long bristle-like hairs. Claws with two teeth.

Type: *Philonix fulvicollis* Fitch.

Ashmead, in Psyche, Vol. X, 1903, p. 148, united *Acraspis* Mayr with *Philonix* Fitch and made *P. fulvicollis* the type of the genus. Fitch's description of *fulvicollis*, however, is too brief for recognition of the species, and perhaps it would be more appropriate to use *Cynips pezomachoides* O. S. for the type of *Philonix*. The males are not known.

Philonix pezomachoides (*Osten Sacken*).

Cynips quercus pisum FITCH, 5th Rep. Nox. Ins. N. Y. (Trans. N. Y. Agricul. Soc. 1858 (1859), p. 818, fig; OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. I, 1861, p. 59; Ent. Zeit. Stettin, 1861, pp. 408, 411. (Gall only.)

Cynips pisum ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 303; BEUTENMÜLLER, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 258; Am. Mus. Journ., Vol. IV, 1904, p. 104, Fig. 34; Ins. Galls Vicin. N. Y., 1904, p. 18, fig. 34; COOK, Proc. Ind. Acad. Sci., 1904, p. 225; 29th Rep. Dept. Geol. & Nat. Hist. Indiana, 1904 (1905), p. 832; JARVIS, 37th Rep. Ent. Soc. Ontario, 1906 (1907), p. 72. (Galls only.)

Cynips pezomachoides OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. I, 1862, p. 250.

Cynips (*Teras*) *pezomachoides* OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 340, 348, 352, 379.

Acraspis pezomachoides MAYR, Gen. Gallenb. Cynip., 1881, p. 31; ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 295; *ibid.*, Vol. XIV, 1887, p. 127; Bull. 1, Col. Biol. Assoc., 1890, p. 38; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 64; BRIDWELL, Trans. Kans. Acad. Sci., Vol. XVI, 1899, p. 203; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Cynips q pezomachoides PACKARD, 5th Rep. U. S. Ent. Com., 1890, p. 113.

Female. Head black, rufous around the eyes or rufous with the vertex and face along the middle black, finely punctate, hairy. Antennæ brownish black, reddish basally, 14-jointed. Mesothorax reddish, parapsidal grooves extending well forward. Pleuræ dark brown black with a rufous patch. Scutellum rufous, pointed. Abdomen smooth, polished, dark brown black, basal segment with a large yellowish brown spot on each side or wholly yellowish brown. Ventral spine and tip of abdomen with long yellowish hairs. Legs rufous, tibiæ sometimes infuscated. Claws large. Wings very short. Length 2 to 3.25 mm.

Gall. (Plate XLIII, Fig. 1.) On the under or upper sides of the leaves of white oak (*Quercus alba*) in August and September. Pale yellowish sometimes tinged with red. Globular and somewhat resembling a pea. Its surface is finely netted with fissures or cracks and intervening elevated points. Inside are usually two larval cells divided by a thin partition. Diameter 5 to 7 mm.

Habitat: Canada; New England and Middle States; Virginia; North Carolina; Ohio; Illinois; Missouri; Indiana; Kansas; Colorado.

The insect described by Fitch as *Cynips quercus pisum* is a guest fly according to Osten Sacken. The types of *C. pezomachoides* are in the Museum of Comparative Zoölogy.

Philonix erinacei sp. nov.

Cynips q. erinacei WALSH, Proc. Ent. Soc. Phila., Vol. II, 1864, p. 483.

Acraspis erinacei MAYR, Gen. Gallenb. Cynip., 1881, p. 30; ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 295; *ibid.*, Vol. XIV, 1887, p. 128; Bull. 1, Col. Biol. Assoc., 1890, p. 38; GILLETTE, 27th Rep. Agricul. Mich., 1888, p. 470; Psyche,

Vol. V, 1889, p. 186; Proc. Iowa Acad. Sci., Vol. I, pt. ii, 1892, p. 112; BEUTENMÜLLER, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 259, pl. xii, fig. 1; Am. Mus. Journ., Vol. IV, 1904, p. 104, fig. 35; Ins. Galls Vicin. N. Y., 1904, p. 18, fig. 35; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 64; BRIDWELL, Trans. Kans. Acad. Vol. XVI, 1899, p. 203; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58; COOK, 29th Rep. Dept. Geol. and Nat. Hist. Indiana, 1904 (1905), p. 832, fig. 25; FELT, Ins. Affect. Park and Woodl. Trees, 1906, p. 627; JARVIS, 37th Rep. Ent. Soc. Ontario, 1906 (1907), p. 70.

Female. Head black, rufous on each side of the face, or around the eyes, finely punctate, with whitish pubescence. Antennæ black, basal joint rufous, 14-jointed. Thorax rufous, narrowly black around the sides and anteriorly. Pleuræ black, with a large rufous mark anteriorly. All minutely punctate, pubescent. Parapsidal grooves distinct posteriorly, obsolete anteriorly. Scutellum rufous, darkest basally, punctate and pointed posteriorly. Metathorax black. Abdomen piceous or rufo-piceous, usually rufous basally and pubescent laterally. Ventral spine and tip of abdomen hairy. Legs yellowish rufous, tibiæ sometimes slightly darker. Wings aborted. Length 1.50 to 3 mm.

Gall. (Plate XLIII, Figs. 2, 3, 4.) Attached by a single point to the leaf and growing on one of the principal veins, but usually on the midrib of white oak (*Quercus alba*). It occurs on both sides of the leaves, and is fully developed late in August and September. Polythalamous rounded or elongate with the surface finely netted with fissures or cracks and more or less densely covered with spines. Yellow sometimes shaded with red with the spines usually red. Length 10–20 mm. Width 6–12 mm.

Habitat: Canada; New England and Middle States; North Carolina; Virginia, probably South to Florida; Michigan, Iowa, Illinois; Ohio; Kansas; Indiana; Colorado (?).

The adult does not appear to have been before described. I have retained Walsh's name *erinacei* which he applied to the gall only. The above description of the adult was made from eighteen specimens bred by the late H. F. Bassett from galls received from Ohio. The types are in the American Museum of Natural History. The gall is quite common in the vicinity of New York.

Philonix echini (*Ashmead*).

Acraspis echini ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, pp. 128, 140; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 64; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Female. Head reddish brown, finely rufous, eyes dark brown, ocelli red, shining. Antennæ 14-jointed, dark brown above, paler beneath, as long as the whole body, filiform, basal joint and some of the others slightly yellowish at the tip. Thorax reddish brown, finely rugose, slightly pubescent. Parapsidal grooves distinct posteriorly. Scutellum reddish brown, bluntly pointed, pubescent. Abdomen bright reddish brown, smooth, shining, compressed, second segment slightly pubescent laterally. Ventral spine hairy. Legs reddish brown, more or less infuscated, particularly along the outer edges of the tibiæ, pubescent. Wings short. Length 3.25 to 3.75 mm.

Gall. (Plate XLIII, Fig. 5.) On the leaves of swamp white oak (*Quercus platanoides*) in autumn. Almost globular, with the surface finely netted or fissured like a strawberry and covered with short spiny prickles. Yellowish in color. Internally there are from one to four cells, but usually only two cells. Diameter 5 to 7 mm.

Habitat: Florida.

The gall somewhat resembles that of *Philonix erinacei* and *Philonix pezomachoides*. It is smaller than *erinacei* and larger than *pezomachoides*. The surface is coarser than in *erinacei* and the spines are considerably shorter.

Philonix prinoides (*Beutenmüller*).

Cynips prinoides BEUTENMÜLLER, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 257, pl. xi, fig. 6; DALLA TORRE and KEIFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 60; FELT, Ins. Affect. Park and Woodl. Trees, 1906, p. 627.

Philonix prinoides ASHMEAD, Cat. Ins. N. J. Smith, 1900, p. 548.

Acraspis prinoides BEUTENMÜLLER, Am. Mus. Jour., Vol. IV, 1904, p. 103, fig. 32, Ins. Galls Vicin. N. Y. 1904, p. 17, fig. 32.

Female. Head wholly black or dark rufous on the sides of the face, almost twice as broad as the thorax, sparsely pubescent. Antennæ 14-jointed, black, basal joints sometimes rufous. Thorax rufous or pitchy brown, very sparsely pubescent, somewhat shining. Parapsidal grooves distinct and extending well forward, convergent at the scutellum. Scutellum rufous, somewhat shining, and bluntly pointed posteriorly. Pleuræ dark rufous. Abdomen black, shining, smooth and inflated, not compressed; on the sides of the second segment are a few hairs, which are difficult to detect. Legs rufous. Wings very short. Length 1.50 to 3.25 mm.

Gall. (Plate XLIII, Figs. 6, 7.) On the upper or under side of the leaves of dwarf chestnut oak (*Quercus prinoides*), usually on the mid rib. In August and September. Monothalamous. Hard and woody. Globular with numerous cone-like projections, each with a long or short bristle. Green or yellowish usually tinged with red. Internally there is a rather large larval chamber. Diameter 6 to 12 mm.

Habitat: New York, New Jersey; Ohio.

The adult is very different from all other species of *Philonix*. The thorax is very narrow, the head is very broad, the parapsidal grooves are distinct and long, and the abdomen is globose. In general appearance the insect mimics a species of beetle of the genus *Anthicus*. The types are in the American Museum of Natural History.

Philonix villosa (*Gillette*).

Acraspis villosus GILLETTE, 27th Rep. Agricul. Mich., 1888, p. 474; Psyche, Vol. V, 1889, p. 218, fig. 4; Proc. Iowa Acad. Sci., 1890, p. 55; *ibid.*, Vol. I, pt. ii, 1892, p. 113.

Acraspis villosa DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 64; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Female. Head punctate with the median line of the face black, cheeks and orbits cinnamon brown. Sometimes the face is nearly black in dark specimens, sparsely pubescent. Antennæ 13-jointed (14?). Thorax brown bordered anteriorly and posteriorly with black, pubescent. Parapsidal grooves wanting. Scutellum punctate, pubescent. Abdomen black, thickly set with yellowish gray pubescence that gives a decided velvety luster to the sides. Anterior dorsal portion of the second segment has a large bare spot that is continued as a line along the dorsum of the succeeding segments. The border of the segments show as black rings crossing the velvety surface. Legs brown, tarsi infuscated. Wings short. Length 4 mm.

Gall. (Plate XLIII, Figs. 8, 9.) On the midrib on the under side of the leaves of burr oak (*Quercus macrocarpæ*) in autumn. Hard globular with fissures and cracks somewhat like the gall of *P. erinacei*, but densely covered with very long bristle-like hairs. Pale yellow. Internally with a single larval cell. Diameter 9–11 mm. Hairs about 3 mm. long.

Habitat: Iowa; Michigan.

The adult of the species is not known to me and the types are with Prof. C. P. Gillette. Cotypes of the galls were kindly given to me by Prof. Gillette. The flies emerge in October.

Philonix hirta (*Bassett*).

Cynips q. hirta BASSETT, Proc. Ent. Soc. Phila., Vol. III, 1864, p. 688.

Cynips hirta OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. IV, 1865, pp. 340, 347, 353.

Cynips (*Teras*) *hirta* OSTEN SACKEN, Proc. Ent. Soc. Phila., Vol. IV, 1865, p. 379.

Biorhiza hirta ASHMEAD, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296; *ibid.*, Vol. XIV, 1887, p. 127; Bull. 1, Col. Biol. Assoc., 1890, p. 38; BEUTENMÜLLER, Bull. Am. Mus. Nat. Hist., Vol. IV, 1892, p. 260; BRIDWELL, Trans. Kans. Acad. Sci., Vol. XVI, 1899, p. 204.

Biorrhiza hirta DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 60; DALLA TORRE and KIEFFER, Gen. Ins. Hymen., Fam. Cynip., 1902, p. 56.

Philonix hirta Ashmead, Cat. Ins. N. J. Smith, 1900, p. 548.

Female. Head black, very dark rufous on each side of the face, minutely rugose. Antennæ pitchy brown black. Mesothorax dull rufous, somewhat infuscated on the disc, pubescent. Parapsidal grooves short. Pleuræ dark brown sometimes marked with rufous. Scutellum pointed, finely rugose, rufous, somewhat infuscated, pubescent. Abdomen pitchy brown, with a pubescent patch on each side of the second segment, the remaining segments, except the first bounded across the back and sides on the posterior edges by a belt of long, grayish white hairs, divided on the dorsal ridge by a shining, smooth narrow line, like the anterior portion of the segments. Legs dark brown, somewhat infuscated. Wings very short, extending a little beyond the scutellum. Length 2 to 3 mm.

Gall. (Plate XLIII, Fig. 10.) On the veins on the upper and under sides of the leaves of chestnut oak (*Quercus prinus*) in September and October. Green or yellowish green. Hard, round, with the outer surface composed of fissures each with a short point. Internally there is a single larval cell. Diameter 4 to 6 mm.

Habitat: Massachusetts; Connecticut; New York; New Jersey; District of Columbia; Pennsylvania; Kansas; Colorado (?).

The gall very much resembles that of *Philonix pezomachoides* but the adult is very different from this species. It is allied to *Philonix macrocarpæ*. The types are in the American Museum of Natural History and the American Entomological Society.

Philonix macrocarpæ (*Bassett*).

Acraspis macrocarpæ Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 84; Gillette, Proc. Iowa Acad. Sci., Vol. I, pt. II, 1892, p. 113; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 64; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58; Jarvis, 37th Rep. Ent. Soc. Ontario, 1906 (1907), p. 69; Beutenmüller, Bull. Am. Mus. Nat. Hist., Vol. XXIII, 1907, p. 466.

Acraspis undulata Gillette, Ent. News, Vol. IV, 1893, p. 28.

Philonix macrocarpæ Ashmead, Cat. Ins. N. J. Smith, 1900, p. 548.

Female. Head black, finely punctate, with minute hairs, mandibles somewhat rufous. Antennæ 14-jointed. Thorax pitchy brown black, sometimes rufous along the lateral margins of the mesonotum; clothed with grayish hairs. Parapsidal grooves indistinct. Scutellum pitchy brown black, finely punctate, pointed posteriorly, pubescent. Pleuræ pitchy brown black. Abdomen pitchy brown black, sometimes paler basally, compressed and the sides covered with gray hairs. Venter, dorsum and tip of abdomen smooth and shining. Legs dark brown. Wings quite short. Length 2 to 2.75 mm.

Gall. (Plate XLIII, Fig. 11.) On the underside of the leaves of burr oak (*Quercus macrocarpæ* and *Quercus undulata*). Usually found on the lateral veins or on the midrib singly or in numbers. Pale green or yellow, oval or rounded. The surface presents a crackled appearance, fine fissures or lines dividing it into a large number of facets, each of which is crowned with a short hard point. Internally is a single larval cell and the space between the inner and outer surface of the gall is filled with a hard pinkish, crystalline, substance. Diameter 2 to 4 mm.

Habitat: Ohio, Michigan, Iowa, New York (St. Lawrence Co.); Colorado (Manitou); Canada (Ontario).

Closely allied to *Philonix macrocarpæ* Bassett. The types of *A. macrocarpæ* are in the American Museum of Natural History and the American Entomological Society and the types of *A. undulata* are with Prof. C. P. Gillette and the American Museum of Natural History.

Philonix nigra (*Gillette*).

Acraspis niger Gillette, Bull. 7 Iowa Agricul. Exp. Sta., 1889, p. 282; Ent. Amer., Vol. VI, 1890, p. 23; Proc. Iowa Acad. Sci., Vol. I, pt. II, 1892, p. 113.

Acraspis nigra Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 64; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Acraspis gillettei Bassett, Trans. Am. Ent. Soc., Vol. XXVI, 1900, p. 323; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Female. Head black or dark reddish black, very minutely rugoso-punctate,

with a few pale hairs. Antennæ black or rufo-piceous, 14-jointed. Mesothorax varying from black to rufous, when rufous it usually has a blackish mark anteriorly. Prothorax black, scutellum black or rufous, metathorax black; all minutely punctate with decumbent, pale hairs; parapsidal grooves, present, distinct posteriorly, obsolete anteriorly. Scutellum pointed posteriorly. Pleuræ black sometimes marked with rufous. Abdomen black, large, with a patch of pale hairs on each side at the base. Ventral spine with long pale yellowish brown hairs. Legs dark brown, pubescent. Wings rudimentary, extending to nearly the middle of the abdomen. Length 2.50 to 3.50 mm.

Gall. (Plate XLIII, Figs. 12, 13.) On the underside of the leaves of white oak (*Quercus alba*), burr oak (*Quercus nacrocarpa*) and dwarf chestnut oak (*Quercus prinoides*) in the fall. Monothalamous. Globular and covered with a short, dense pubescence, which give them the appearance of felt. Pale ashen gray brown, but brown if long exposed to the weather. Internally is a larval cell kept in place by a spongy mass that is loosely fibrous on the inner surface of the gall. The outer shell is thin and hard. Diameter 6 to 11 mm.

Habitat: Connecticut; New York; New Jersey; Pennsylvania; Ohio; Illinois; Michigan; Iowa.

The adult is subject to variation as regards the coloration of the head and thorax. These parts vary from black to rufous in twenty specimens before me. *Acraspis niger* was described from a single specimen with the head black and the thorax a little reddish brown above. *Acraspis gillettei* was described from specimens with the head and thorax dark reddish brown. The gall is usually quite abundant on the leaves of *Quercus prinoides*. They become easily detached and may be found on the ground under the trees. The fly emerges the following summer. The type of *A. nigra* is with Prof. C. P. Gillette and the types of *A. gillettei* are in the American Museum of Natural History and the American Entomological Society.

Philonix lanæglobuli (*Ashmead*).

Acraspis lanæglobuli Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, pp. 128, 139; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 64; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Female. In size and general appearance very closely resembles *Acraspis echini*; but differs as follows: mandibles black; antennæ brown black from sixth to terminus, although the fifth joint is also sometimes black at base; the legs are not obfuscated and the posterior coxæ is very hairy; the abdomen is pale and the terminal segments are blackish. Length 4 to 4.50 mm.

Gall: On the under side of the leaves of swamp white oak (*Quercus platanoides*). Round or globular, slightly attached to the leaf and covered with a fine, dense, grayish pubescence. Internally of a pithy structure, with a large thin shelled kernel in the centre. Diameter 7.50 to 8 mm.

Habitat: Florida.

This species is not known to me; the type is in the United States National Museum.

Philonix compressa (*Gillette*).

Acraspis compressus Gillette, Ill. State Lab. Nat. Hist., Vol. III, 1890, p. 197.

Acraspis compressa Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 64; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Female. Head and thorax rufous, abdomen black, head nearly twice as broad as thorax, the latter very small and narrow, abdomen very much compressed and when viewed from the side, appearing twice as large as the head and thorax together; vertex and occiput dark brown, mandibles black, clypeus punctured and with few hairs. The entire head covered with a net-work of depressed lines; antennæ rufous, 14-jointed. Thorax very small and narrow, seeming, when viewed from above, out of all proportion with the comparatively large and very broad head; sculptured like the head without the usual furrows. Scutellum very narrow and much elevated posteriorly, and appearing when viewed laterally, in the shape of a crow's beak; a shining transverse groove but no foveæ at base. Abdomen very strongly compressed, not broader in the thickest part than the thorax, shining black in color with some rufous at base, free from hairs or punctures, as deep as long, its length compared with that of the entire insect being as 3 to 5 and the second segment occupying fully two thirds of the dorsum. Feet dark reddish brown. Wings entirely wanting.

Gall. Attached to the underside of the leaves of red oak (*Quercus rubra*) and scarlet oak (*Quercus coccinea*) in the fall, about the time the leaves are beginning to turn brown. Subglobular bodies from 2 to 3 mm. in diameter. The galls appear like wax, and are either pure white or tinged with red while on the leaves, and when cut into are fleshy and juicy like a potato. They fall to the ground with or a little before the leaves, and each develops a single larva which gets its growth in the fall but does not emerge until the following summer. Only a very thin shell of the gall is left after the fly emerges.

Habitat: Iowa (Ames); New York (Westchester Co.).

The adult of this species is not known to me and Prof. Gillette's decription of it and of the gall is here reproduced. I have taken the galls in numbers at Katonah, Westchester County, New York, on the undersides of the leaves of the Scarlet Oak (*Quercus coccinea*) but did not succeed in rearing the flies. The gall is a pretty wax-like object and is easily detached from the leaves. My specimens were collected in October and November. If I remember rightly, I have also taken the galls in New Jersey and on Long Island, New York, some years ago. The adult, according to Gillette, is destitute of wings, and the abdomen is very much compressed. The types are in the State Laboratory of Natural History, at Urbana, Illinois.

Philonix polita (*Bassett*).

Acraspis politus Bassett, Trans. Am. Ent. Soc., Vol. XVII, 1890, p. 85.

Acraspis polita Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 64; Dalla Torre and Kieffer. Gen. Ins. Hymen. Fam. Cynip., 1902, p. 58.

Female. Entirely black. Head smooth, shining. Antennæ 14-jointed, first

joint large, club-shaped, second joint oblong-ovate, third joint as long as the first and second together, fourth joint two thirds as long as the third, remaining joints rather short. Thorax very small, smooth and shining. Scutellum minute, short and without foveæ. Legs brownish black, shining; tarsi brownish. Wings wanting. Length 1.75 mm.

Gall. Unknown.

Habitat: Missouri (Washington County).

The smallest known species of *Philonix.* The types are in the American Entomological Society.

Philonix fulvicollis *Fitch.*

Philonix fulvicollis Fitch, 5th Rep. Nox. Ins. N. Y. (Trans. N. Y. Agricul. Soc., 1858 (1859), p. 783); Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, p. 333; Ashmead, Psyche, Vol. X, 1903, p. 143.

Teras fulvicollis Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, p. 379.

Biorhiza fulvicollis Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296.

Biorrhiza fulvicollis Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 60; Dalla Torre and Kieffer, Gen. Ins. Hymen., Fam. Cynip., 1902, p. 56.

According to Fitch this species measures .13 to .15 of an inch (= 3.25 to 3.75 mm.) and is black with the thorax tawny yellow, spotted anteriorly with black, the scutellum brighter yellow, and the legs dusky or blackish with the knees and hips of a paler dull yellowish color, the antennæ being black to their bases. The thorax when carefully inspected shows a broad black stripe on its fore part, on each side of which is a small oval black spot and further down upon each side, forward of the wing sockets, is a large triangular black spot. The insect is found in the latter part of November and the beginning of December.

Philonix nigricollis *Fitch.*

Philonix nigricollis Fitch, 5th Rep. Nox. Ins. N. Y. (Trans. N. Y. Agricul. Soc., 1858 (1859), p. 783); Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, p. 353.

Cynips (Teras) nigricollis Osten Sacken, Proc. Ent. Soc. Phila., Vol. IV, 1865, p. 379.

Biorhiza nigricollis Ashmead, Trans. Am. Ent. Soc., Vol. XII, 1885, p. 296.

Biorrhiza nigricollis Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 61; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Fitch states that this species is smaller than *P. fulvicollis,* being less than .12 of an inch in length (3 mm.) and is black with the basal third of the antennæ and legs obscure yellowish brown and the scutellum yellow. The inner sides of the thighs are slightly dusky.

The species cannot be identified from the brief description.

Zopheroteras *Ashmead.*

Zopheroteras ASHMEAD, Can. Ent., Vol. XXIX, 1897, p. 261; Psyche, Vol. X, 1903, p. 148.

Trigonaspis DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Allied to *Philonix.* Scutellum rounded or semicircular, rounded off posteriorly and separated from the thorax by a delicate groove-like line. Antennæ 14-jointed, long, third joint as long or nearly as long as the fourth and fifth united, sixth to thirteenth joints a little more than twice as long as thick. Head and thorax feebly shagreened. Claws of hind tarsi without a tooth.

Type: *Acraspis vaccinii.* Ashmead.

Zopheroteras vaccinii (*Ashmead*).

Acraspis vaccinii ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, pp. 127, 136; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 64.

Zopheroteras vaccinii ASHMEAD, Can. Ent., Vol. XXIX, 1897, p. 261.

Trigonaspis vaccinii. DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 56.

Female. Head and thorax dull brown, feebly shagreened. Antennæ black, brown from eight joint to tip brown. Parapsidal grooves very indistinct, more or less distinct posteriorly. Scutellum separated from the thorax by a delicate groove. Abdomen black shining, sometimes brown basally. Legs pale with the tibiæ dark brown along the outer edges. Wings entirely wanting. Length 2 mm.

Gall. (Plate XLII, Fig. 6.) In clusters on the midrib on the under side of the leaves of post oak (*Quercus minor*) in autumn. They grow in numbers on the opposite sides of the rib. Monothalamous, somewhat bell-shaped and greenish in color gradually becoming reddish late in the season. They are attenuated at the base into a short petiole, fastened to the rib, and at the opposite end they are truncated, and excavated, making their shape somewhat like that of a huckleberry blossom. Length 3 to 4 mm.

Habitat: New England States south to Flordia and Texas.

The gall begins to develop in August, but does not reach maturity until late in the fall. The types are in the U. S. National Museum.

Parateras *Ashmead.*

Parateras ASHMEAD, Can. Ent., Vol. XXIX, 1897, p. 262; Psyche, Vol. X, 1903, p. 149; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 57.

Allied to *Biorhiza.* Antennæ 14-jointed, third joint long, but much shorter than the fourth and fifth united. Head and thorax finely shagreened. Parapsidal grooves distinct. Scutellum small, hightly convex or elevated with a distinct transverse fovea at the base. Hind tarsi longer than the tibiæ, the claw with a distinct tooth beneath.

Type: *Parateras hubbardi.*

Parateras hubbardi *Ashmead.*

Parateras hubbardi Ashmead, Can. Ent., Vol. XXIX, 1897, p. 262; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 57.

Female. Head and thorax reddish brown, finely alutaceous or leather-like. Antennæ black or brown black, first two joints ferruginous. Parapsidal grooves distinct and meeting at the base of the scutellum. Scutellum darker than thorax. Abdomen black pitchy brown toward the base. Legs pale brown with the tibiæ outwardly dark brown or blackish, tarsi more or less dark brown. Wings rudimentary. Length 2 mm.

Habitat: Michigan (Detroit).

Nothing is known regarding the habits of this species. The types are in the U. S. National Museum.

Xystoteras volutellæ *Ashmead.*

Xystoteras volutellæ Ashmead, Can. Ent., Vol. XXIX, 1897, p. 260; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 57.

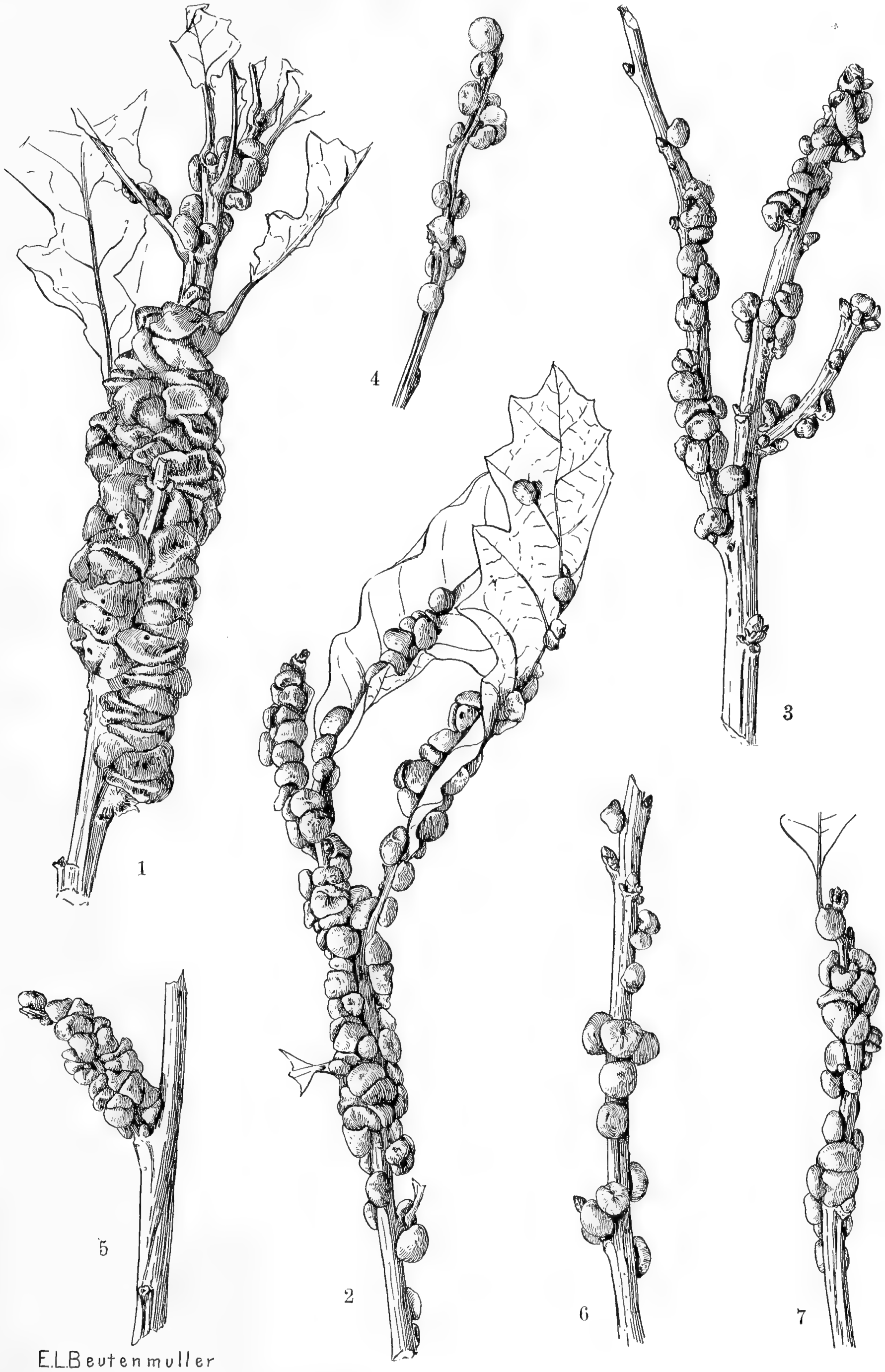
Acraspis volutellæ Bridwell, Trans. Kansas, Acad. Sci., Vol. XVI, 1899, p. 203.

Female. Wholly black and very sparsely pubescent. Head not punctate. Antennæ 14-jointed. Thorax smooth and without parapsidal grooves. Scutellum shagreened and somewhat densely pubescent, obtusely rounded posteriorly, foveæ at base wanting, but with a depression across the base. Mesothorax smooth, with a deep vertical femoral depression. Abdomen large, bare and polished. Ventral spine with spine-like pubescence. Legs honey yellow, entirely black, except that the knees are dull. Wings rudimentary. Length 2 mm.

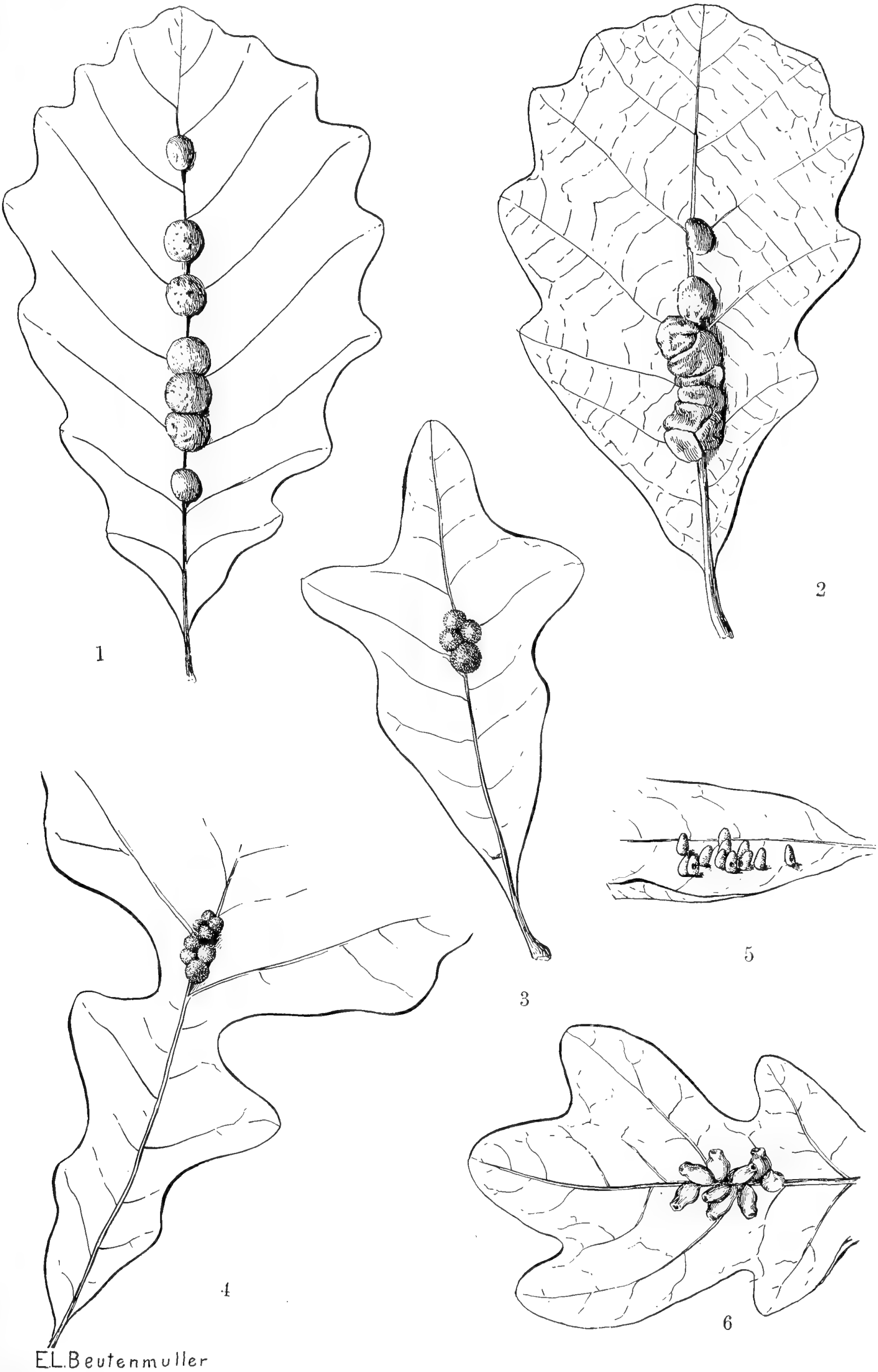
Gall. (Plate XLII, Fig. 5.) Singly or in numbers on the under side of the leaves of burr oak (*Quercus macrocarpa*). Conical, bluish gray. Top truncate and internally it is hollow, with the larvæ cell or kernal, resembling a minute nipple, situated at its base. The gall is attached to a leaf by a few fibres and may easily be detached. The color of the gall is produced by a powdery or primrose bloom, which completely covers it when fresh. Height 3 to 3.5 mm., by 2.50 mm. in diameter at base.

Habitat: Kansas (Manhattan, Riley Co.); Ohio (Cincinnati).

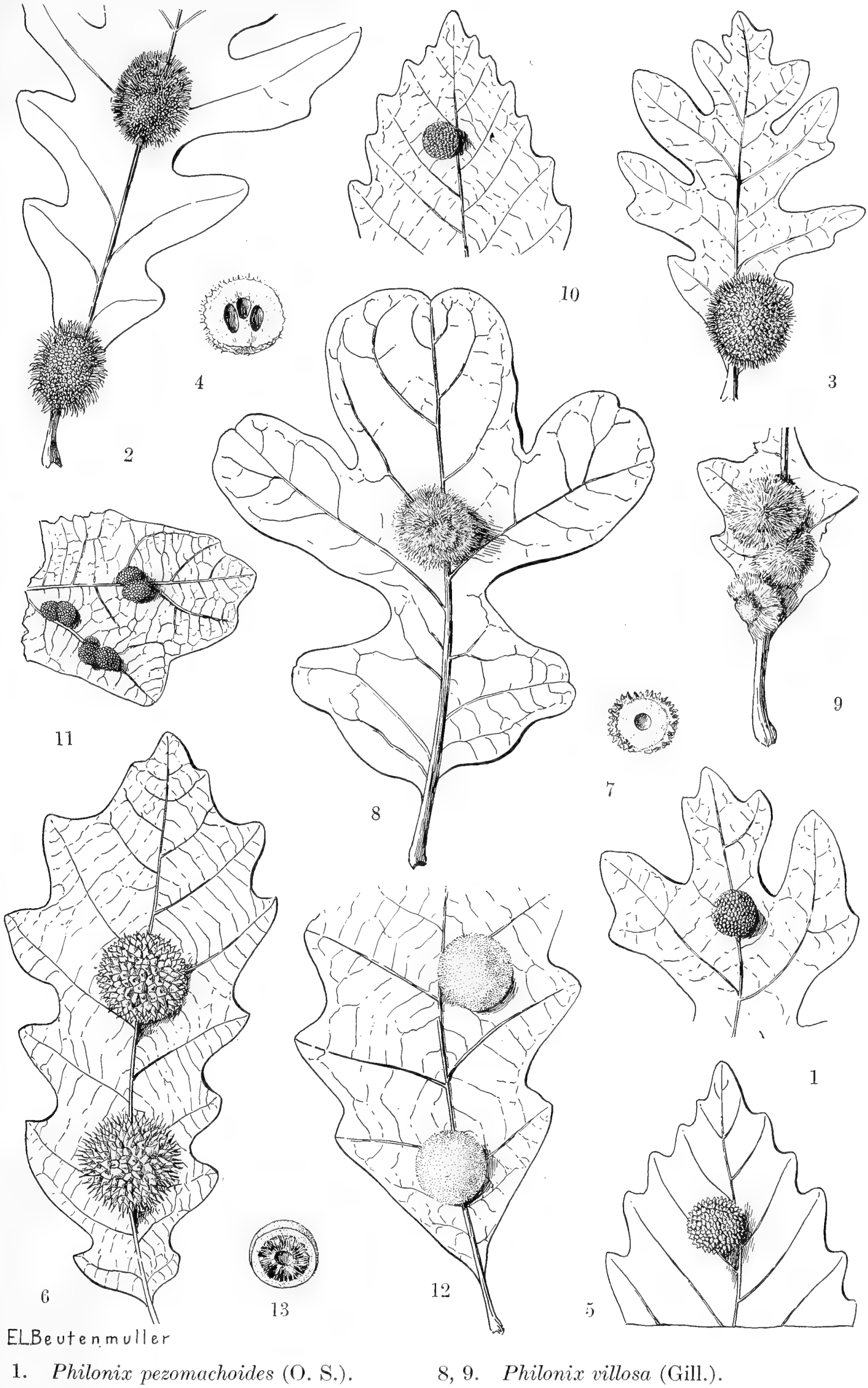
This species was described from a single female and the male is not known The types are in the United States National Museum. I received galls of this species on the leaves of a shingle oak (*Quercus imbricaria*) collected by Miss Annette Braun, near Cincinnati, Ohio. These galls only produced guest flies.



1. *Biorhiza forticornis* (Walsh), on white oak (*Quercus alba*).
2–7. " " " on dwarf chestnut oak (*Quercus prinoides*).



1, 2. *Biorhiza forticornis* (Walsh), on leaves of dwarf chestnut oak (*Quercus prinoides*).
3, 4. *Biorhiza mella* Ashm. 5. *Xystoteras volutellæ* Ashm.
6. *Zopheroteras vaccinii* (Ashm.).



1.	*Philonix pezomachoides* (O. S.).	8, 9.	*Philonix villosa* (Gill.).
2–4.	" *erinacei* sp. nov.	10.	" *hirta* (Bass.).
5.	" *echini* (Ashm.).	11.	" *macrocarpæ* (Bass.).
6, 7.	" *prinoides* (Beuten.).	12, 13.	" *nigra* (Gill.).

59.7,31S(52)

Article XIX.—A NEW GOBLIN SHARK, *SCAPANORHYNCHUS JORDANI*, FROM JAPAN.

By L. Hussakof.

Plate XLIV.

Four specimens of the rare Japanese shark *Scapanorhynchus* (*Mitsukurina*) have recently come into my hands for study. Two were generously placed at my disposal by Professor Bashford Dean, one belongs to the American Museum collection, and the fourth (a head only) was secured for me in Japan by my friend Dr. N. Yatsu of the Imperial University at Tokyo. On comparing these specimens among themselves and with the description and figures of *S. owstoni* (Jordan),[1] it was seen that they differed markedly in certain regards from that species, though agreeing entirely among themselves. Since the type species is known from at least two carefully figured specimens — one a male 42 inches long (type), the other[2] a female 11 feet long — the characters of the four specimens in hand, three females and one (head only) apparently a male, are not to be regarded as mere sex or age variants, but as indicating a distinct species. This may be defined as follows.

Scapanorhynchus jordani n. sp.

Similar to *S. owstoni* (Jordan) in general proportions and in the form, size and position of the fins, but different in a number of important characters as shown in the following table. (Figs. 1 *A*, 1 *B*.)

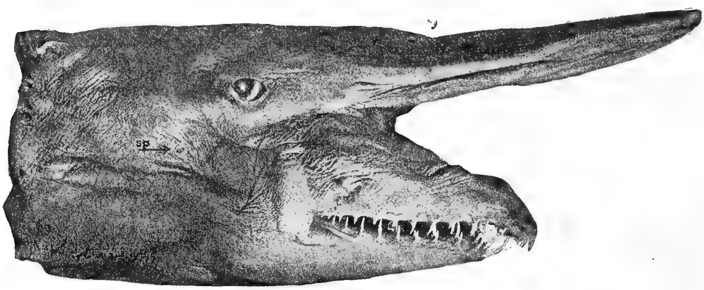
	S. owstoni	*S. jordani* n. sp.
Jaw	Greatly protrusible. When fully protruded a deep >-shaped excavation between jaw and lower surface of rostrum.	Slightly protrusible. Very little or no excavation between jaw and rostrum.

[1] Jordan, D. S., Description of a species of fish (*Mitsukurina owstoni*) from Japan, the type of a distinct family of lamnoid sharks. Proc. Cal. Acad. Sci. (3), I, 1898, pp. 199–202, pls. xi and xii.

[2] Bean, Barton A., Notes on an adult goblin shark (*Mitsukurina owstoni*) of Japan. Proc. U. S. Nat. Mus., XXVIII, 1905, pp. 815–818, 8 figs.

	S. owstoni	*S. jordani* n. sp.
Mouth	Cleft of mouth horizontal (as seen in profile in the protruded jaw).	Cleft of mouth sloping backward and upward at angle of about 30°.
Eye	Anterior margin on a vertical through a point $\frac{1}{2}$ to 2 diameters of eye back of angle of jaw.	Above middle of lower jaw.
Interorbital space	$2\frac{2}{3}$ times in snout (measured to eye).	Slightly less than 2.
Nostril	On a vertical through a point one diameter of eye anterior to angle of jaw.	On vertical through anterior extremity of lower jaw.
Gills	Large. Length of gill area 5 in head (according to figure of type).[1] Depth of last gill, 6 in head.	Relatively smaller. Length of gill area 6.5 to 7 in head. Depth of last gill, 7.6 in head.

A



B

Fig. 1. Heads of (*A*), *Scapanorhynchus owstoni* (after Jordan); (*B*), *S. jordani* n. sp. *A*, from a photograph kindly loaned by Prof. B. G. Wilder. *sp*, spiracle.

Detailed measurements of the two sharks taken as the types are given in the following table. One (1.155 M.) is in the Zoölogical Department at Columbia University, the other (1.30 M.) is in the American Museum of Natural History.

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[1] According to the type description this is $2\frac{2}{3}$ — apparently an error.

Scapanorhynchus jordani n. sp.	Columbia University Cotype ♀	Amer. Museum Cotype ♀
	M.	M.
Total length (tip of rostrum to tip of tail)	1.155	1.300
Depth at origin of pectoral	.110	.135
Depth at first dorsal	.135	.145
Tip of rostrum to eye	.180	.210
Head (tip of rostrum to first gill-opening)	.290	.325
Tip of rostrum to origin I dorsal	.430	.470
" " " " " II "	.630	.710
" " " " " pectoral	.330	.360
Base I dorsal	.066	.063
" II "	.060	.060
" ventral	.110	.115
" anal	.095	.120
Posterior termination base II dorsal to end of caudal	.470	.525
Greatest depth of caudal	.110	.120
Length of gill area	.042	.050
Depth of last gill	.038	.042
Distance of posterior rim of eye to spiracle	.036	.040
Interorbital area	.096	.107
Rostrum (under side measured from jaw)	.145	.170
Longer diameter of eye	.015	.018
Spiracle	.0035	.002
Head in total length	3.900	4.000
Greatest depth in total length	8.500	8.900
Snout (from eye) in head	1.600	1.600
Length of gill area in head	6.900	6.500
Depth of last gill " "	7.600	7.700

Named for President David Starr Jordan, who has contributed so largely to our knowledge of the fishes of Japan, and who was first to bring to notice a living representative of this ancient type of fish.

Remarks on the Proper Name of the Genus.

1898.[1] In the original description President Jordan says: "The genus is apparently unique among living forms, its nearest relative being apparently the genus *Carcharias* of Rafinesque, which is *Odontaspis* of Agassiz. This group contains few recent sharks, but is rich

[1] Proc. Cal. Acad. Sci. (3), I, p. 201.

in fossil forms. Unless place can be found for it in some family of fossil species, it must stand as the type of a distinct family *Mitsukurinidæ*."

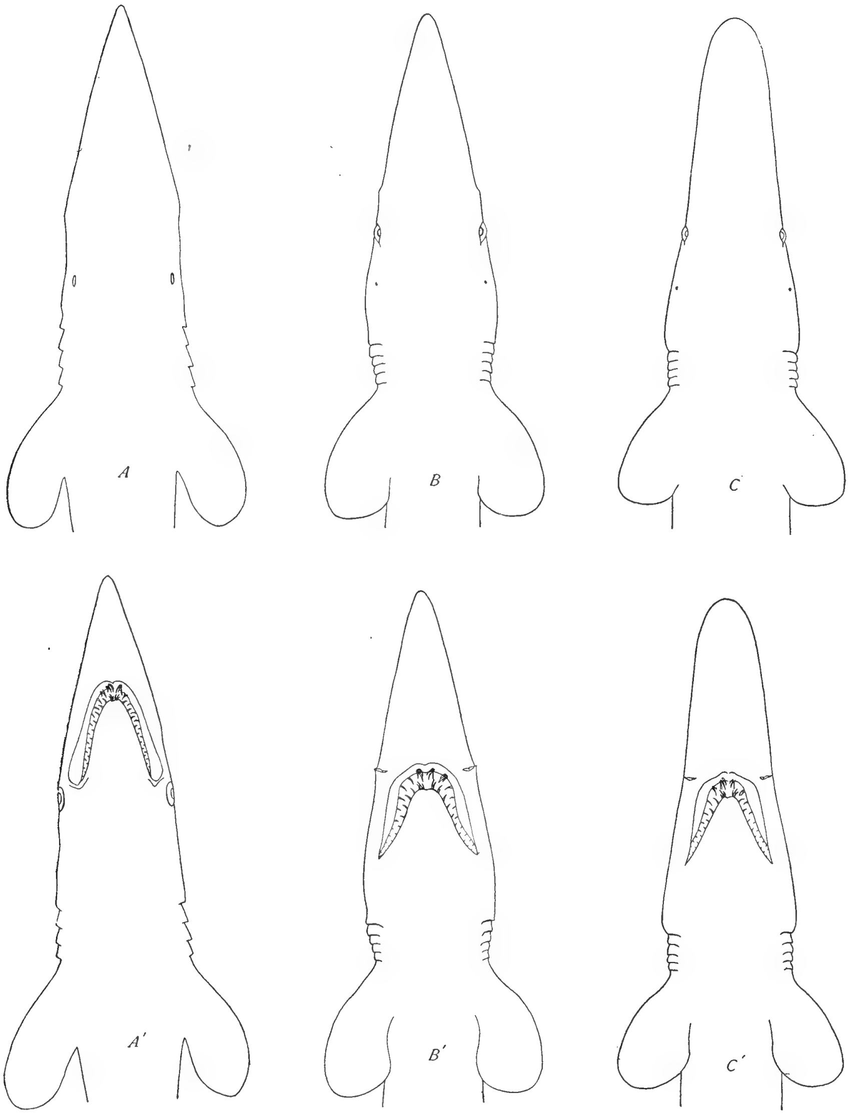

Fig. 2. Heads of *Scapanorhynchus*, to show variations in length and form of rostrum. Dorsal (*A*), and ventral (*A'*), views of *S. owstoni* (after Jordan). Dorsal (*B*, *C*), and ventral (*B'*, *C'*), views of two specimens of *S. jordani* n. sp.

1899.[1] Dr. A. S. Woodward calls attention to the identity of *Mitsukurina* with the Cretaceous genus *Scapanorhynchus,* pointing out that the differences between the two forms in length of rostrum, body-proportions and fins are "not of greater than specific value."

1902.[2] G. B. Howes refers to *Mitsukurina* as "a genus whose grotesqueness leaves no doubt of its identity with the Cretaceous lamnoid *Scapanorhynchus.*"

1903.[3] Prof. Bashford Dean refers to additional specimens of this shark taken in Japanese waters and doubts the propriety of separating it from the odontaspids as a distinct family.

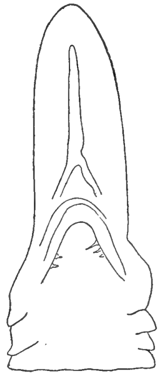

Fig. 3. *Scapanorhynchus lewisii* (Davis). Rostrum and jaws, × about ½. Upper cretaceous: Mt. Lebanon, Syria. After figure by A. S. Woodward of a specimen in British Museum (49474).

1904.[4] Prof. Léon Vaillant discusses briefly the column, cranium and gills in a specimen 2.50 M. long, said to be the first received in Europe; remarks on its resemblance to *Oxyrhina, Lamna* and *Odontaspis,* but regards it as a distinct genus. Disputes propriety of founding a separate family for it. "Il ne diffère des elasmobranches auxquels il est ici comparé, que par des caractères de second ordre et se rattache directement à la famille des *Lamnidæ,* telle qu'elle a été comprise par M. Günther."

1905.[5] Dr. Barton A. Bean describes and figures a specimen of this shark 11 feet long; retains name *Mitsurkurina.*

1906.[6] Mr. C. Tate Regan refers to the type species as *Scapanorhynchus owstoni* and places it in the family Odontaspididæ.

In the light of present knowledge, I believe there can be no doubt of the generic identity of *Mitsukurina* with the Cretaceous *Scapanorhynchus.* The variations in the length and form of the rostrum in *Scapanorhynchus* are not greater than those in the living species. (*Cf.* Figs. 2 and 3.) The rostrum is rounded in both female specimens here made the types of *S. jordani,* exactly as in a specimen of *S. lewisii* (Davis) from the Cretaceous

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[1] Ann. Mag. Nat. Hist. (7), III, p. 487.
[2] Proc. Brit. Assoc. Adv. Sci., Belfast, p. 626.
[3] Science, N. S., XVII, p. 630
[4] C. R. Acad. Sci. Paris, 138, pp. 1517–1518.
[5] Proc. U. S. Nat. Mus., XXVIII, pp. 815–818, 8 figs.
[6] Proc. Zool. Soc. London, 1906, p. 744.

figured by Woodward[1]; and the large eleven foot specimen figured by Bean shows that the rostrum varied in relative size with age, becoming proportionally shorter in old individuals.

Regarding the family position, there is no doubt that *Scapanorhynchus* is closely related to the Odontaspididæ but whether of that family or constituting a distinct family remains to be seen from a more careful anatomical study than any now available.

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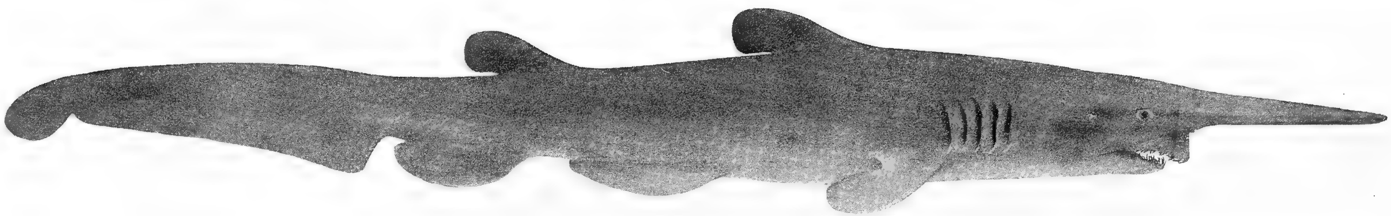
[1] Catal. Fos. Fishes Brit. Mus., Part I, 1891, pl. xvii, fig. 2.



SCAPANORHYNCHUS JORDANI n. sp.

From a model of the American Museum cotype, by Mr. Dwight Franklin

56.7.43A

Article XX.—THE SYSTEMATIC RELATIONSHIPS OF CERTAIN AMERICAN ARTHRODIRES.

By L. Hussakof.

Plate XLV.

In studying a natural group of organisms it is of primal importance to ascertain the kind and degree of structural modifications to which the generalized forms have given rise. In the case of the Arthrodira, a group wholly extinct, our knowledge of the interrelationships of the various types is still rather vague, owing partly to the scantiness of materials and partly to the dispersal of these materials in widely separated museums making comparative studies difficult to carry out. The following notes are offered as a small contribution to this subject. They include a discussion of the synonymy of several long-known arthrodires and a description of a new genus and species.

Brachygnathus n. gen.

Type species: *Brachygnathus* (*Dinichthys*) *minor* (Newberry).

In 1878 Newberry described an arthrodire, *Dinichthys minor*, on the evidence of three plates — a median occipital, a dorsomedian and a right mandible. These plates were subsequently figured and redescribed in his 'Paleozoic Fishes of North America' in 1889.[1]

While studying these specimens recently, I have observed that they differ widely from their homologues in *Dinichthys*, so much in fact, as to require separation into a distinct genus. This genus differs more in appearance and structure from *Dinichthys* than the latter does from *Coccosteus*.

The dorsomedian plate, as already indicated in Newberry's figure, instead of being anteriorly emarginated as is the rule in the Arthrodira,[2] is drawn out into an elongate cusp (Fig. 1*B*). From several available specimens in the Newberry Collection at the American Museum, I have been enabled to draw a tolerably accurate restoration of this plate which is here reproduced (Fig. 1*A*; *cf*. Fig. 2). The body of the plate is relatively shorter

[1] Monogr. U. S. Geol. Sur., XVI, p. 149, pl. viii, figs. 3–5.

[2] *Cf*. a juvenile specimen of apparently this genus recently figured by Prof. Bashford Dean in Amer. Mus. Memoirs, IX, p. 280. A somewhat similar element is also figured by Dr. C. R. Eastman in his 'Devonic Fishes of Iowa,' 1908, p. 206, fig. 32.

and broader than in *Dinichthys*, the posterior process longer and more slender.

It is to be expected from the characters of this dorsomedian that other structural peculiarities will be found when the osteology of this form becomes

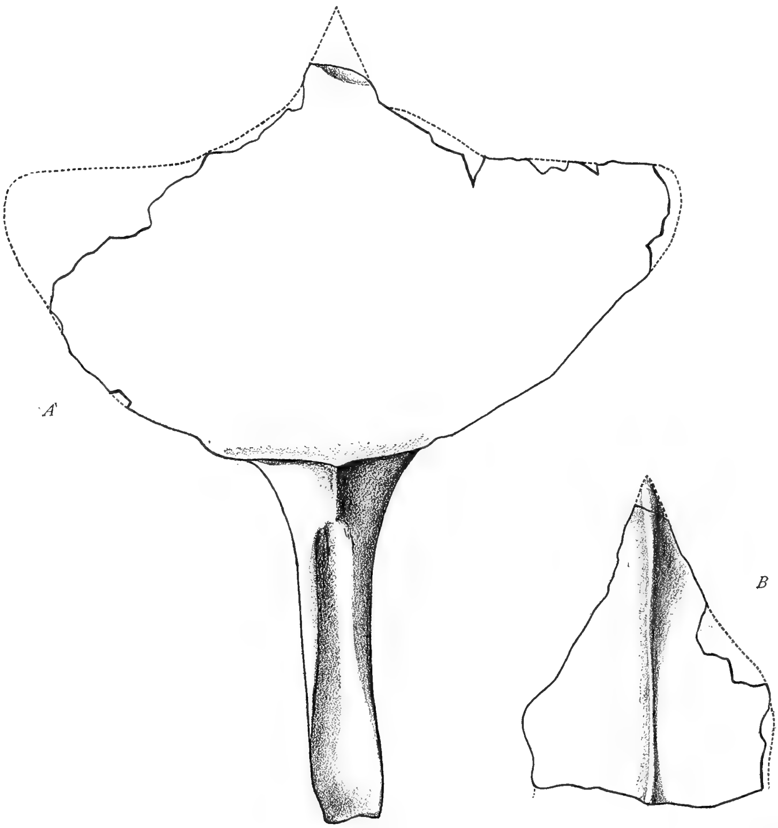


Fig. 1. *Brachygnathus minor* (Newb.). *A*, Dorsomedian plate. *B*, Anterior extremity belonging to type dorsomedian. Newberry Collection, Amer. Mus., No. 118. × ½. Cleveland shale (Upper Devonic): Ohio.

known. This is the case with the other two elements known, the mandible and the median occipital.

The mandible is here figured in outer and inner aspects (Fig. 3). It measures 85 mm. in total length. It will be noted that for an arthrodire mandible it is singularly short fore-and-aft, predicating a form much more brachycephalic than either *Dinichthys* or *Coccosteus*. The gape of the mouth is smaller than in these genera. There is no trace of the second

cusp or "tooth" which in *Dinichthys* follows the first, the cutting edge being a regular knife-like blade. In this regard *Brachygnathus* agrees with *Stenognathus,* though in other characters the two are very different, *Stenognathus* having a long slender mandible suggesting a dolichocephalic form with a wide mouth (*cf.* Figs. 3 and 4). It may be mentioned in passing,

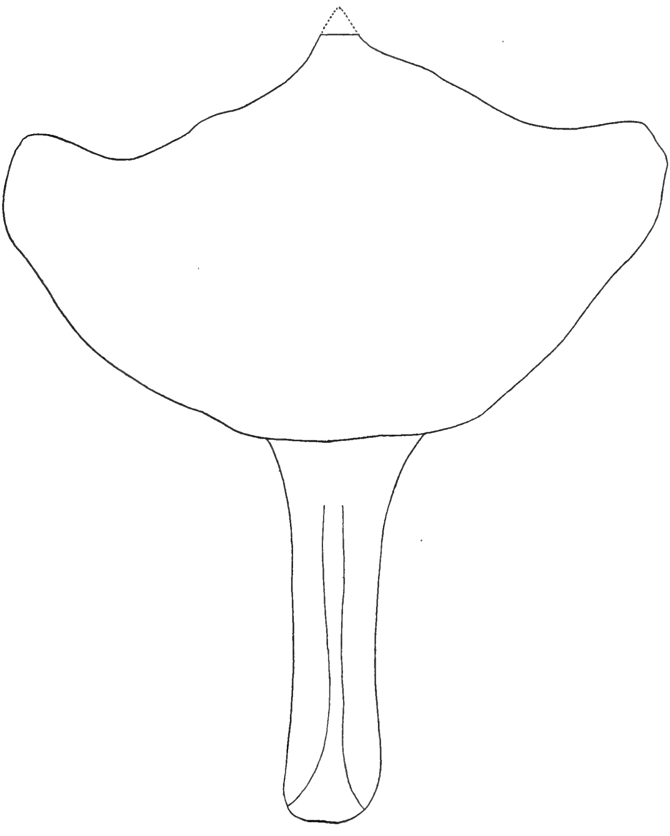


Fig. 2. *Brachygnathus minor* Newb. Dorsomedian, $\times \frac{1}{2}$. (From a field sketch made by the collector, Jay Terrell).

that the mandible of *Brachygnathus* indicates unmistakably the flattened, semicircular posterior process to which the writer has called attention [1] as showing that the arthrodiran mandible was attached to a cartilaginous support rather than articulated posteriorly to a bony pivot.

The median occipital element has already been carefully described and figured by Newberry.[2] The fact that some half dozen such elements are to

[1] Mem. Amer. Mus. Nat. Hist., IX, 1906, p. 114.
[2] Monogr. U. S. Geol. Surv., XVI, 1889, p. 149, pl. viii, figs. 3, 4.

be found in the Newberry collection alone goes to show that the genus was abundant in individuals; and probably when more of its history is known, these median occipitals will turn out to represent more than one species. It is rather curious that each of these elements is complete and shows the anterior thinned flange which interlocked with the parts of the head in front.

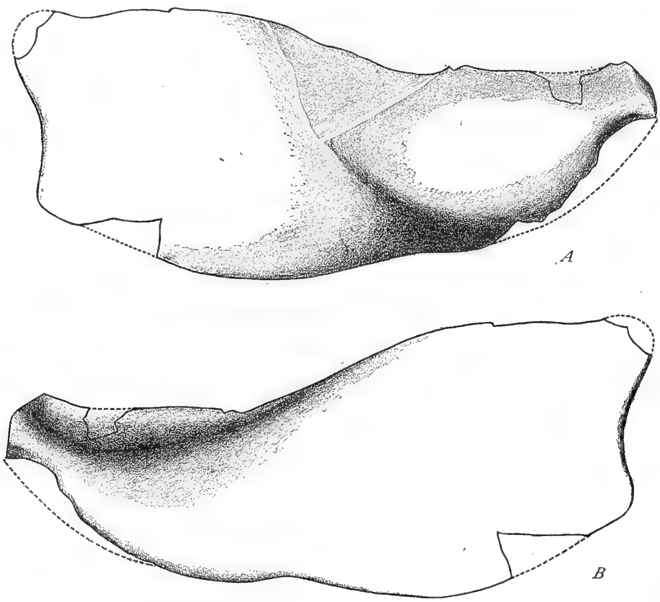


Fig. 3. *Brachygnathus minor* (Newb.). Mandible, natural size, in outer (*A*), and inner (*B*), view. Newberry Coll., Amer. Mus. No. 118. Cleveland shale: Ohio.

This indicates that the median occipital became readily extricated in the dissolution of the creature. But whether it prove that the exoskeleton of the genus was only partially ossified with the plates embedded in the softer parts, as supposed by Newberry,[1] it would be idle to speculate.

Brachygnathus minor (*Newberry*).

1878. *Dinichthys minor* Newberry, Ann. N. Y. Acad. Sci., I, p. 191.
1889. *Dinichthys minor* Newberry, Paleoz. Fishes, p. 149, pl. viii, figs. 1–5.
1908. *Dinichthys minor* Newb., Hussakof, Bull. Amer. Mus., XXV, p. 12.

An imperfectly definable species of arthrodire known at present only from three dermal plates: a dorsomedian, a median occipital and a right

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[1] Monogr. U. S. Geol. Surv., XVI, p. 149.

mandible. Specific characters of these plates comprised in the generic description above. Plates ornamented superficially with crape-like wrinklings.

Type specimen from the Cleveland shale (Upper Devonic) of Ohio. Newberry collection, Amer. Mus., No. 118.

Stenognathus corrugatus (*Newberry*).

1889. *Dinichthys corrugatus* NEWBERRY, Paleoz. Fishes, p. 151, pl. vii, figs. 3, 3a.
1893. *Dinichthys gracilis* CLAYPOLE, Amer. Geologist, XII, p. 279, fig.
1897. *Stenognathus corrugatus* NEWBERRY (DEAN), Trans. N. Y. Acad. Sci., XVI, p. 30, pl. xxiv, figs. 27, 28.

A cast of Claypole's type of *Dinichthys gracilis* is preserved in the American Museum. On comparing it with Newberry's type of *Steno-*

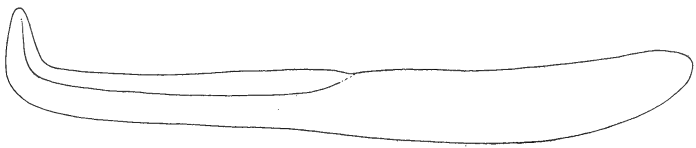

Fig. 4. *Stenognathus corrugatus* (Newb.). Mandible, × ⅓. Cleveland shale (Upper Devonic): Ohio.

gnathus corrugatus, no doubt is left that the two forms are identical. Newberry's two specimens are the front halves of mandibles, lacking the posterior blade portions, while Claypole's is a complete mandible (Fig. 4).

It may here be recalled that the diagnostic characters of this genus as given by Newberry are the very slender form of the mandible and the absence of the second cusp, or "tooth,"—the one which in *Dinichthys* follows the main upturned fang. The entire functional portion of the upper margin of the mandible is therefore one uninterrupted cutting edge. In this regard *Stenognathus* resembles *Brachygnathus.*

Mylostoma variabile *Newberry.*

1883. *Mylostoma terrelli* NEWBERRY, Trans. N. Y. Acad. Sci., II, p. 147.
1889. *Mylostoma terrelli* NEWBERRY, Paleoz. Fishes, p. 164, pl. xiv, figs. 1, 2.
1906. *Mylostoma terrelli* NEWB., EASTMAN, Bull. Mus. Comp. Zool., L, p. 23, pl. iii, fig. 21.
1908. *Mylostoma variabile* NEWB., HUSSAKOF, Bull. Amer. Mus., XXV, p. 17.

In the catalogue of the types of fossil fishes in the American Museum (Bull. Amer. Mus. Nat. Hist., XXV, pp. 16, 17), I have indicated that I regard

M. terrelli as a synonym of *M. variabile.* This conclusion was the result of a careful comparison of practically all the originals preserved — those at the American Museum, the Harvard Museum and the Oberlin College Museum. It remains here to give the reasons for this opinion.

Mylostoma terrelli was founded by Newberry upon a single specimen of a left mandible.[1] The reasons for differentiating it from *M. variabile*[2] appear to have been, first, its larger size, and, secondly the belief at the time it was described that it came from a lower horizon (Huron shale) than *M. variabile* (Cleveland shale). The latter point, however, appears to have been an error. Many of the first finds from the same locality (Sheffield Township, Lorain Co., Ohio), were originally labeled by Newberry as from the Huron shale. Subsequent geologic work, however, proved this determination of the horizon erroneous, and on many original labels in the Newberry Collection, we find the words *Huron shale* stricken out and *Cleveland shale* substituted in Newberry's own hand.

The only legitimate reason for differentiating *Mylostoma terrelli* from *M. variabile,* therefore, appears to be that of size; and this is not a valid ground for specific separation. In general form and in the possession of the tubercle, the type specimen — the only one known — agrees entirely with a typical mandible of *M. variabile.* Its greater size, worn-down tubercle and general flattened and triturated oral face, indicate that it belonged to a very old individual. Recalling that in the closely related genus *Dinichthys* very large worn mandibles are known, indicative of the good old age reached by this arthrodire, it is not surprising to find a similar instance of senility among the mylostomids.

Dinognathus ferox n. gen., n. sp.

An imperfectly definable genus and species of arthrodire known at present only from a single dental plate. Form of dental plate as shown in figure 5; bilaterally symmetrical, the lower third formed into two dinichthyid-like "teeth" of about the size of the "premaxillaries" in *Dinichthys intermedius.* These "teeth" functional, as indicated by the lines of wear. Near upper margin of functional face, an oval boss occupying about one-third the width of the element at its widest part; this boss apparently not functional. Reverse side of dental element smooth, and comparable with the reverse or inserted surface of a mylostomid palatal plate. Lateral faces smooth, slightly oblique, the inserted surface being slightly broader than the functional one — as in a mylostomid pavement plate. Maximum thickness about one-third the width of the element at its middle.

The type specimen was discovered by Mr. Peter A. Bungart of Lorain Co., Ohio,

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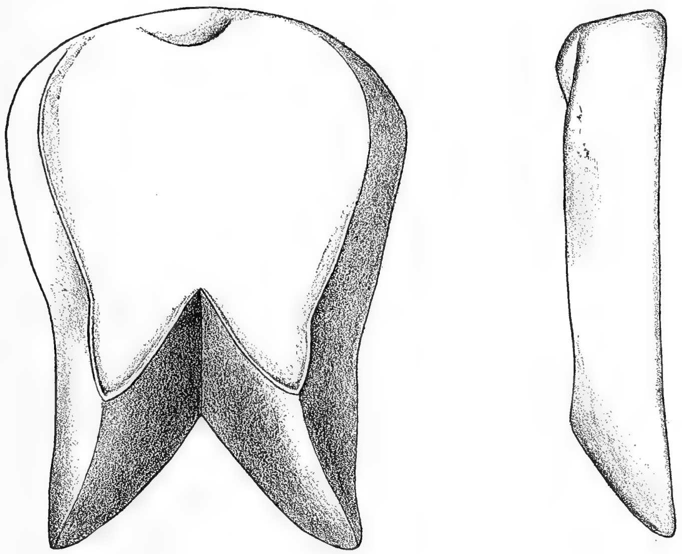
[1] Trans. N. Y. Acad. Sci., II, 1883, p. 147.
[2] *Ibid.*, p. 146.

in whose private collection it is preserved. I am indebted to him for the privilege of examining it.

This extraordinary element differs from all arthrodire dental plates now known. Its perfect symmetry and clean-cut lateral faces preclude any idea of its being a malformed element due to the fusing of the extremities of a pair of mandibular or upper "teeth." Its symmetry and the fact that the tips of the fangs point away from each other suggest that the element was set in the median line of the jaw. Its resemblance to a mylostomid palatal plate suggests, furthermore, that it was embedded in cartilage by its



A B

Fig. 5. *Dinognathus ferox* n. gen., n. sp. Dental element in oral (A), and lateral (B), view. Type. × ¾. Cleveland shale (Upper Devonic): Ohio.

reverse, or smooth, side. But whether it represents the fused "premaxillaries" or is a premandibular placed at the symphysis, cannot at present be decided.

To students of the Arthrodira an alternative interpretation will perhaps occur which may here be briefly noticed. In the early days of arthrodire discoveries in Ohio, Newberry, Claypole and others believed that the deep groove in the mandible of *Titanichthys* was set with a few strong teeth, and that future discoveries would bring these teeth to light. Newberry, in fact, figured a small plate which he interpreted as such a tooth; but excepting this — which was an error in identification [1] — no evidence for

[1] Monogr. U. S. Geol. Surv., XVI, pl. xliii, fig. 4. The element here figured is one of a pair of small plates placed on either side of the pineal on the ventral aspect of the cranial shield.

teeth in *Titanichthys* has been forthcoming. It is probable therefore, that the dental element here discussed will be declared by some paleichthyologist to be one of the long-looked-for "teeth" of *Titanichthys.*

In answer to this possible interpretation the writer would say that such a view does not seem to him to be warranted by the character of the present dental plate. Its form is not suggestive of having been set in a titanichthid mandible. From the analogy of other arthrodires the teeth in the mandible should all point approximately in the same direction, whereas in the present element the two teeth point in opposite directions (*cf.* Fig. 5 A). Its surface texture, by reason of its density, is more suggestive of a dinichthid or a mylostomid dental than that of a *Titanichthys.*

Coccosteus fossatus (*Eastman*).

1907. *Protitanichthys fossatus* Eastman, Mem. N. Y. State Mus., 10, p. 144, pl. 10, fig. 2, and text fig. 30.
1908. *Protitanichthys fossatus* Eastman, Ann. Rept. Geol. Surv. Iowa, p. 201, fig. 30.

The writer has elsewhere [1] called attention to the fact that the proposed genus *Protitanichthys* was founded upon rather doubtful grounds. In the following remarks it is proposed to deal more at length with this matter.

The genus was based upon a single head shield displaying the inner aspect and lacking the posterior, or median occipital, region. Both sensory canals and sutures can be clearly made out owing to the unusual mode of preservation and fracture of the specimen. The photograph here reproduced (Pl. XLV) gives a clear idea of the characters of this form; and the outline (Fig. 7), which is made from a careful tracing, presents graphically the result of a close study of the original. It may be noted in passing that this outline differs considerably from that by Dr. Eastman [2] accompanying the original description.

The character upon which Dr. Eastman laid most stress in the original description, and which influenced him in selecting the generic name, was the supposed presence of a short-and-broad pineal element — a feature which he regarded as suggestive of titanichthid affinities. But there can be no doubt, I believe, after a close scrutiny of the specimen, that the pineal is not really of that form, but rather elongated fore-and-aft as in typical coccosteids. A transverse flexure across the middle of the pineal (clearly shown in the photograph as a transverse shadow) was apparently taken by Dr. Eastman for the posterior suture of the plate. The specimen clearly

[1] Science, N. S., XXVIII, 1908, p. 312.
[2] Mem. N. Y. State Mus., 10, 1907, fig. 30.

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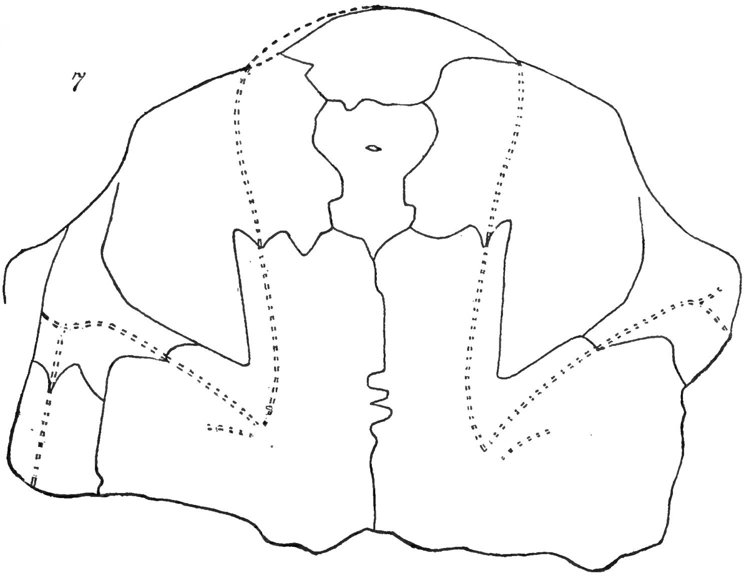

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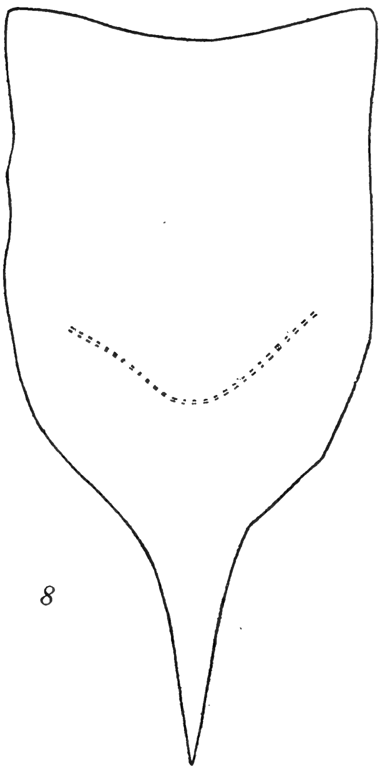

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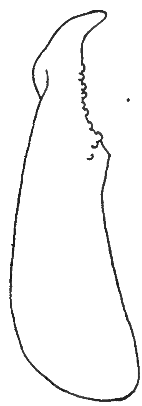


Head shield, dorsomedian and mandible of probably the same species of coccostean. Natural size. Delaware limestone (Mid. Devon.) : Delaware, Ohio.

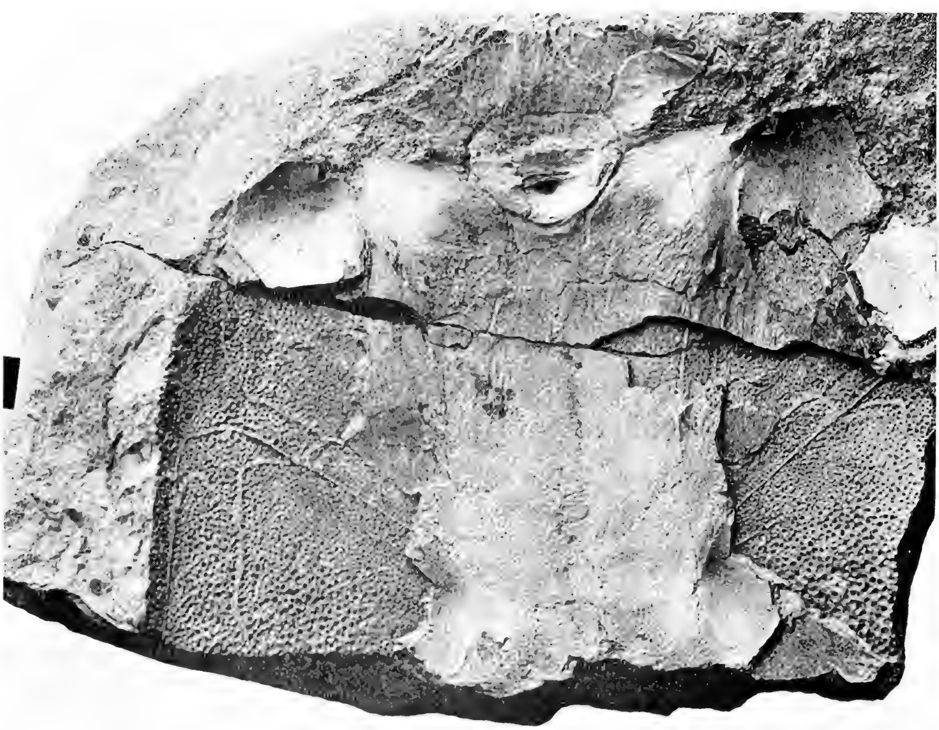
Fig. 6. "*Liognathus*" *spatulatus* Newb. Right mandible, inner view. Newberry Coll., Amer. Mus. No. 325.

Fig. 7. *Coccosteus* (*Protitanichthys*) *fossatus* (Eastman). Head shield. Original in Museum of Comparative Zoölogy, Harvard University.

Fig. 8. *Coccosteus occidentalis* Newb. Dorsomedian, outer view. Newberry Coll., Amer. Mus. No. 313.

shows the outline of the pineal to be that indicated in Figure 7; in fact its lateral sutures are partially brought out in Plate XLV and can be clearly seen in the original photograph. Hence the pineal of this head shield shows no anomalous characters. Except for trivial details it is like that of other coccosteans.

In other regards, such as size, shape of the several elements, direction of the sensory canals and ornamentation, the specimen is typically coccostean. Moreover, it was found in a formation (Delaware limestone) from which remains of two other coccosteids have been described — *Coccosteus occidentalis* (dorsomedian Fig. 8, and median ventral) and *Liognathus spatulatus* (mandible, Fig. 6); indeed, the tubercular ornamentation of the cranial shield of *Protitanichthys* is indistinguishable from that of the dorsomedian of *Coccosteus occidentalis.* It seems reasonably certain therefore, that all these fragments, which have received different names, represent one species; at any rate *Protitanichthys* and *C. occidentalis* appear to belong together. But in default of demonstrative evidence of such specific identity it is expedient to retain the several specimens under different specific names. But certainly it would be unjustifiable to refer the newly discovered head shield to a distinct genus.



HEAD SHIELD OF *Coccosteus fossatus* (EASTMAN). × $1\frac{1}{4}$.

Original in the Museum of Comparative Zoölogy, Cambridge, Mass.; kindly loaned by Dr. C. R. Eastman.

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Article XXI.— FURTHER NOTES ON *EUBALÆNA GLACIALIS* (BONN.).

By Roy C. Andrews.

Plates XLVI–L.

On December 10, 1908, the writer received word that a North Atlantic Right Whale, *Eubalæna glacialis* (Bonn.), had been captured by Capt. J. B. Edwards, off the village of Amagansett, Long Island, N. Y. Proceeding at once to the place, the animal, a very young female, was found on the beach partly buried in the sand. The body was intact and although no opportunity was given for study upon the skeleton,[1] photographs and measurements of the external characters were secured. Since good photographs and measurements of this species are extremely rare, it seems worth while to publish the material obtained at this time. With it is also included a figure of the baleen of the large female Right Whale taken at Amagansett on February 22, 1907, of which notice was given by the writer in a preceding volume of this Bulletin.[2]

Size.— The total length was 8480 millimeters, or 27 feet, $9\frac{3}{4}$ inches. The animal was lying upon the breast, and the measurement was taken from the tip of the snout to the notch of the flukes along the median line of the back.

Color.— The entire body was ivory black with the exception of the region just above the posterior insertion of the left pectoral fin (see Plate XLVIII, Fig. 1). At this point and backward half way to the flukes, a number of small white patches and narrow streaks of varying length which extended entirely through the skin to the blubber, were to be seen. Although these areas were of irregular outline and gave the appearance of being scratches or scars, upon examination they showed no indication of previous injury. A few small white flecks were present along the anterior edge of the left pectoral fin at the tip, and two white streaks, 100 millimeters long on the superior surface of the left lobe of the flukes. The interior surfaces of the lips were light gray-blue and the mucous membrane in the roof of the

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[1] During a heavy storm on the day following the capture of the whale, its body was lost.

[2] Notes on the External and Internal Anatomy of *Balæna glacialis* Bonn. Bull. Amer. Mus. Nat. Hist., Vol. XXIV, 1908, pp. 171–182.

mouth pale pink. The blubber was light yellowish and 90 millimeters thick on the back.

Proportions.

	mm.	%
Total length (tip of snout to notch of flukes	8480	100.
Tip of snout to eye	1900	22.40
" " " " ear	2180	25.70
" " " " blowhole (center)	1450	17.09
" " " " posterior insertion of pectoral	2540	29.95
" " " " anterior end of 'bonnet'	380	4.48
Distance from eye to ear (center)	380	4.48
Distance of ear above eye	190	2.24
Length of opening of eye	40	.47
" " " " ear	5	.05
Eye above corner of mouth	150	.43
Notch of flukes to posterior insertion of pectoral	5940	70.04
Length of pectoral (tip to anterior insertion)	1530	18.04
" " " (" " posterior ")	1320	15.56
Greatest breadth of pectoral	920	10.84
Flukes from tip to tip	3280	38.67
Greatest breadth of flukes (antero-posterior)	1040	12.26
Length of right lobe of flukes (axially)	1880	22.16
" " left " " " "	1980	23.34
Depth of notch of flukes	170	2.00
Greatest thickness of flukes at insertion	230	2.71
Depth of peduncle at anterior insertion of flukes (on curve)	690	8.13
Length of right blowhole (straight)	180	2.12
" " left " "	200	2.35
Distance between blowholes anteriorly	80	.94
" " " posteriorly	250	2.94

The most striking thing brought out by a comparison of the measurements of this individual with those of other American and European specimens is the great proportionate size of the flukes.

The length of the left lobe and the breadth antero-posteriorly are respectively 2.5% and 1.9% greater than the maximum of other recorded specimens. In the table given by True [1] the minimum measurement from tip to tip is 30% of the total length of the animal and the maximum 35.4%. The flukes of this whale from tip to tip measure 38.6% of the entire length, being 3.2% greater than the maximum for previous specimens. Thus a range of individual variation of 8.6% is given for this measurement of the flukes of *E. glacialis.*

The pectorals exceed the maximum of other specimens both in proportionate length and breadth. It was not possible to obtain a measurement

[1] The Whalebone Whales of the Western North Atlantic, p. 247.

from the tip to the head of the humerus (which is in most cases the only really satisfactory one), but as the fins were extended at right angles to the body the points of posterior and anterior insertion were well defined. The posterior margin of each flipper was broken by a shallow notch or concavity near the tip; this was not present in the fins of the specimen taken on February 22, 1907, at Amagansett, but was indicated in the young female killed at Wainscott on the same day.

It was impossible to obtain a satisfactory measurement of the circumference of the whale; however, the body was greatest in the transverse diameter opposite the tip of the pectorals when laid back. The extreme contraction of the caudal portion of the animal at the "small" is well shown in Plate XLVI. When removing the flukes the body was severed 1170 mm. in front of their anterior insertion; at this point the transverse diameter was 510 mm. and the vertical diameter 1000 mm.

The 'bonnet' of this whale was large and extended posteriorly in an irregular line along the mid-dorsal ridge of the head almost to the anterior ends of the blowholes. This area was thickly covered with parasitic Amphipod crustaceans (*Cyamus*). (See Plates XLIX and L.) On either side of the mandibular symphysis, and at a point just above the eye, were large patches where the parasites had found lodgment. Also smaller masses were present at various points along the rami of the mandible and on the lips. The superior margins of both lips were irregularly scalloped, the crenulations being well marked.

The 'bonnet' was removed and sent to the Museum where it is now preserved.

Eubalæna glacialis (*Bonn.*).

Fig. 1. Side view of head.

Fig. 2. Front view of head, 'bonnet' removed.

Eubalæna glacialis (*Bonn.*).

Fig. 1. Oblique front view.

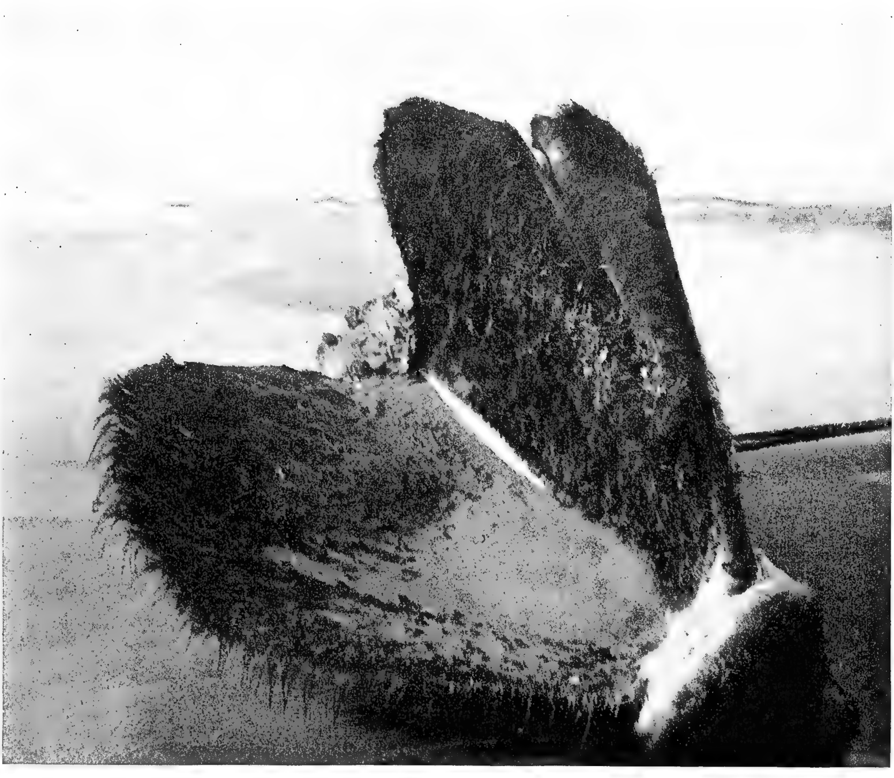
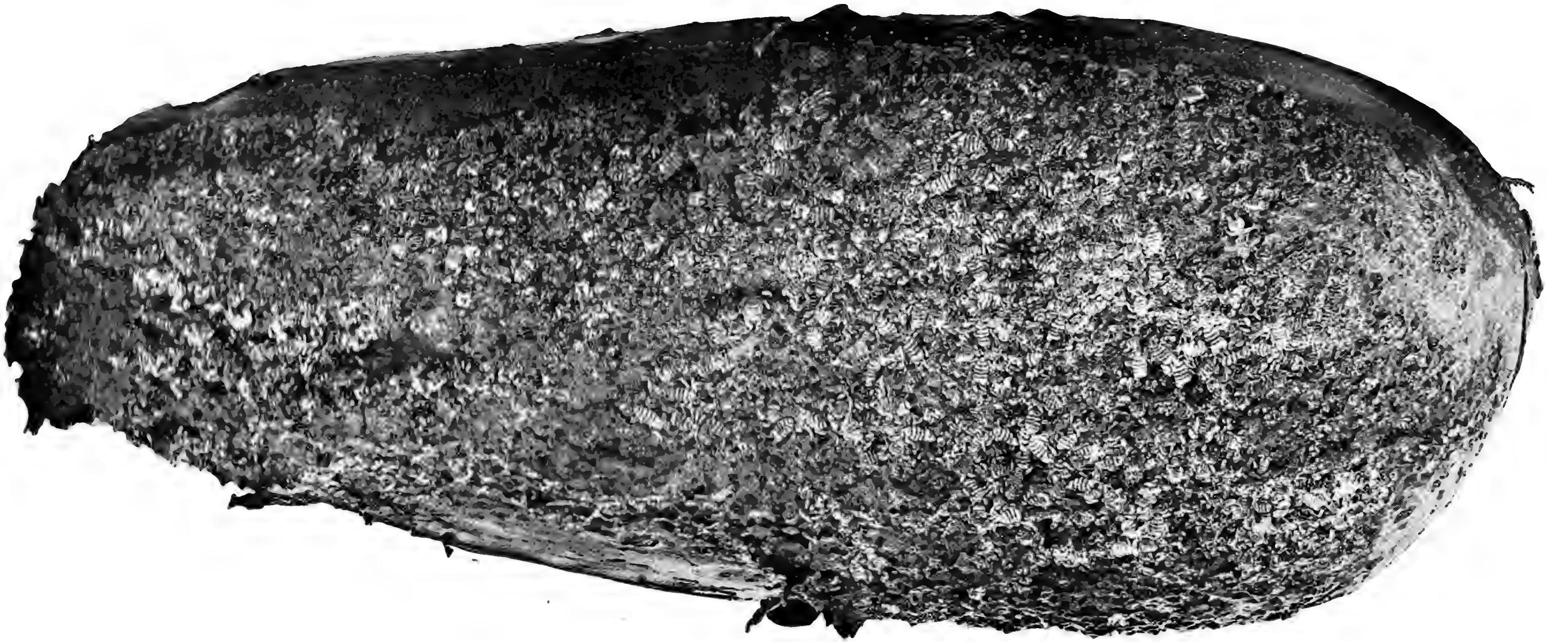


Fig. 2. Inner view of baleen, Amagansett specimen, Feb. 22, 1907.

EUBALÆNA GLACIALIS (*Bonn.*).



Eubalæna glacialis (*Bonn.*).

'Bonnet,' top view, showing parasitic crustaceans (*Cyamus*).

Eubalæna glacialis (*Bonn.*).

'Bonnet,' side view.

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Article XXII.— SOME NORTH AMERICAN CYNIPIDÆ AND THEIR GALLS.

BY WILLIAM BEUTENMÜLLER.

PLATE LI.

The present paper includes the genera *Eumayria Belenocnema, Solenozopheria,* and *Compsodryoenus,* and forms the sixth installment of my papers on North American Cynipidæ.

Eumayria *Ashmead.*

Eumayria ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 147; Psyche, Vol. X, 1903, p. 153; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Male. Antennæ long, filiform, 18-jointed; third joint very long, strongly curved, following joints short, gradually subequal, excepting the last joint, which is slightly longer than the preceding. Thoracic and wing characters as in the genus *Diastrophus,* excepting that there is an indistinct median line of faint punctures on the mesothorax; posterior margin of thorax straight, slightly ridged. Mesopleuræ striate. Abdomen ovate, slightly compressed beneath. The second segment occupies more than two-thirds its whole length. Third segment short, following segments very short.

Female. Antennæ 14-jointed and much shorter than in the male; gradually thickened, third joint not especially long, not as long nor as thick as the first and about twice as long as the fourth, other joints short, last joint large and stout, more than twice as long as the preceding, and shows evidences of being composed of three closely connected joints. Abdomen compressed, truncate posteriorly, ventral valve long and projecting. Other characters as in the male.

Type: *Eumayria floridana* Ashmead.

Eumayria floridana *Ashmead.*

Eumayria floridana ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 147; Psyche, Vol. X, 1903, p. 153; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 106; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 68.

Eumayria multiarticulata ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 133 (gall only).

Male. Black, antennæ and legs reddish, coxæ black; tegulæ yellowish brown. Head finely and evenly punctate. Mesothorax smooth, shining, parapsidal grooves distinct, widely separated at the scutellum. Median line fine, consisting of faint punctures. Pleuræ punctate and striate, subopaque. Scutellum rugoso-punctate, foveæ at base deep and separated by a distinct carina. Abdomen smooth, shining.

Wings hyaline, pubescent, veins yellowish brown. Areolet very minute, scarcely evident, cubital cell two thirds closed. Length 2.75–3.25 mm.

Female. Similar to the male in color, but the head and pleuræ are sometimes dark rufo-piceous. The median line on the mesothorax more distinct and the antennæ are decidedly thickened at the tip.

Gall. On the roots of laurel-leaf oak (*Quercus laurifolia*). Polythalamous. Hard, rounded and composed of many hard larval cells.

Habitat: Florida.

The types are in the United States National Museum and one male and one female are in the collection of Mrs. A. T. Slosson.

Belenocnema *Mayr.*

Belenocnema Mayr, Gen. Gall. Cynip., 1881, p. 16; Cresson, Syn. Hymen. N. Am., pt. i, 1887, pp. 26, 29; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 79; Ashmead, Psyche, Vol. X, 1903, p. 150.

Dryorhizoxenus Ashmead, Trans. Am. Ent. Soc., Vol. IX, 1881, p. xxv; *ibid.*, Vol. XIV, 1887, p. 133.

Female. Head somewhat triangular in front. Cheeks with a moderately deep groove to the mandibles. Clypeus transversely quadrate, produced over the mouth. Antennæ 14-jointed. 1st joint very stout; 2d joint small; 3d joint long and slender and considerably longer than the 1st and 2d together; 4th joint shorter than the third, remaining joints gradually decreasing in length. Mesothorax with two deep parapsidal grooves, median groove present or wanting. Scutellum rounded at tip, and with a broad groove at base, limited by an elevated anterior margin, which is connected with the margin that surrounds the scutellum. Abdomen connected with the metathorax by a short peduncle, slightly compressed, second segment covering half of the abdomen, ventral spine hairy. Wings with radial area short, open at the margin, with the veins curved inwardly. Areolet distinct. Anterior tibiæ armed with two strong spines at the tip; posterior femora quite stout; coxæ stout; claws simple.

Male. Antennæ 15-jointed, filiform, second joint small, slightly elongated, third longer than in the female, excised, each joint widening and truncate at the tip. Abdomen long-ovate; front tibiæ frequently unarmed; otherwise as the female.

Type: *Belenocnema treatæ* Mayr.

Belenocnema treatæ *Mayr.*

Belenocnema treatæ Mayr, Gen. Gall. Cynip., 1881, p. 16; Ashmead, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 133; Dalla Torre, Cat. Hymen., Vol. II, 1893, p. 131; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 79.

Dryorhizoxenus floridanus Ashmead, Trans. Am. Ent. Soc., Vol. IX, July, 1881, p. xxv; *ibid.*, Vol. XII, 1885, p. 291; *ibid.*, Vol. XIV, 1887, p. 133.

Female. Bright shining yellowish brown. Head finely punctate, eyes, tips of mandibles and ocelli black. Antennæ dark brown, basal joint yellowish brown. Mesothorax convex, smooth, shining, parapsidal grooves deep and converging toward the scutellum. Median groove fine, distinct, and running from the scutellum to the

anterior portion of the mesothorax. Prothorax and pleuræ punctate, the latter with a large shining area. Metathorax rugose. Scutellum rugose. Abdomen smooth, shining. Wings hyaline, veins brown, radial vein conspicuously bordered with dark brown. Length to 4–5 mm.

Male. Smaller than the female, a slight depression extending from the outer ocelli over to the eyes; mandibles reddish brown; palpi paler. Antennæ 15-jointed, wholly brown black. Tibiæ and tarsi less densely hairy, blackish, with the spines on the anterior tibiæ less developed than in the female. Abdomen elongate-ovate, smooth and shining, second segment occupying half the surface, other segments gradually decreasing in size. Length 4.5 mm.

Gall. (Plate LI, Fig. 1.) In clusters around the rootlet of live oak (*Quercus virginiana*). Polythalamous. Irregular in shape, somewhat wedge-shaped, soft, fleshy and of the consistency of a potato when fresh. Externally rough, irregular and of a yellowish color. Hard, brown and woody when dry. Internally composed of numerous cells one above another, and separated by thick fleshy partitions. Length from 10 to 20 mm.

Habitat. Florida.

The types are in the United States National Museum.

Belenocnema colorado *Gillette.*

Belenocnema colorado Gillette, Ent. News, Vol. IV, 1893, p. 210; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 79.

Female. "General color dark rufous. Head entirely rufous, but rather lighter in color than the other parts of the body. Head: Facial carina rather prominent, labrum elevated at the free end and slightly notched, sculpturing of face consisting of fine impressed lines outlining small, more or less hexagonal areas; mandibles and palpi pale yellowish, ocelli approximate, a tinge of black about he base of each, occiput slightly tinged with black; first joint of antennæ rufous, second tinged with same color, the following joints black, third joint as long as fourth and fifth together. Thorax smooth and shining, parapsidal grooves very distinct, median groove absent; scutellum rugose, without foveæ, but with broad basal groove; pleuræ of pro- and mesothorax smooth and shining, the mesothorax striated on a small part of its surface, immediately beneath the base of the wing; the prothoracic pleuræ are sparsely punctured and near the anterior coxæ are striated. Abdomen dark rufous shading into black at the tip, the second segment bearing a few scattered hairs at the side. Wings hyaline, nervures distinct, but without smoky margins, radial nervure long and but little curved, and the radial cell long and narrow, cubital nervure reaching the first transverse areolet median in size. Legs dark rufous, the femora being lightest in color. Length 5.50 mm. C. P. Gillette."

Habitat. Dolores, Colorado. Pecos, New Mexico (T. D. A. Cockerell).

This species was described from a single specimen taken June 18, 1892, by Prof. C. P. Gillette. It is allied to *B. treatæ,* but differs by the absence of the median groove on the mesothorax and infuscations on the radial veins. The gall is not known. It probably occurs on the roots of oak. The type is with Prof. Gillette.

Solenozopheria *Ashmead.*

Solenozopheria ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, p. 149; Psyche, Vol. X, 1903, p. 212; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 77.

Allied to *Loxaulis* MAYR. Thorax with two nearly parallel, narrow parapsidal grooves, distinct posteriorly, subobsolete anteriorly. Scutellum prominent, cushion-shaped, without foveæ, but a slightly curved depression at the base. Abdomen short, much broader vertically than long, compressed. Ventral valve rather prominent and squared off at a right angle. Second segment occupies half of the whole surface, third segment hardly half as long as the second, fourth and fifth very short, others hidden. Wings with the veins as in *Loxaulis*, bu the second longitudinal vein very faint and without a cubitus. Areolet very small.

Type: *Solenozopheria vaccinii* Ashmead.

Solenozopheria vaccinii *Ashmead.*

—— Osten Sacken, Ent. Zeit. Stettin, Vol. XII, 1861, p. 416.

Solenozopheria vaccinii ASHMEAD, Trans. Am. Ent. Soc., Vol. XIV, 1887, pp. 134. 149; Psyche, Vol. X, 1903, p. 212; DALLA TORRE, Cat. Hymen., Vol. II, 1893, p. 57; DALLA TORRE and KIEFFER, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 77; BEUTENMÜLLER, Am. Mus. Journ., Vol. IV, 1904, p. 108, fig. 45; Ins. Galls Vicin. N. Y., 1904, p. 22, fig. 45; FYLES Rep. Ent. Soc. Ont., 1904 (1905), p. 95, fig. 16; JARVIS, Rep. Ent. Soc. Ont., 1906 (1907), p. 72.

Female. Slender, pale yellowish brown with the surface microscopically rugose, but not shining. Ocelli and eyes brown. Antennæ 13-jointed, very slightly and gradually thickened toward the tip, with the terminal two thirds infuscated. Thorax with two narrow parapsidal grooves, much more distinct posteriorly than anteriorly. Scutellum cushion-shaped with a curved depression at the base, finely rugoso-punctate. Abdomen with the terminal segments brown. Tibiæ and posterior femora infuscated with a darker shade of brown on their upper edges. Wings hyaline, pubescent, radial cell open, cubitus obsolete, veins brown; the first cross-vein stout, and margined with a faint yellowish cloud. A slight yellowish cloud in the break of the second longitudinal vein, the areolet and base of the radial cell, all enclosed in the same colored cloud. Length 2.25 mm.

Gall. (Plate LI, Figs. 2–8.) On the stems of various kinds of blueberry (*Vaccinium pennsylvanicum, V. corymbosum, V. canadense, V. vacillans*), and huckleberry (*Gaylussacia dumosa, G. frondosa, G. resinosa*). Polythalamous. Green and fleshy when fresh, brown, hard and pithy when old and dry. Irregularly rounded, and usually kidney shaped. Concave at the place of attachment to the stem, turning the same downward. Diameter 12 to 25 mm.

Habitat. Canada to Florida and Texas.

The gall is usually very abundant, but the true gall-maker seems to be difficult to obtain. I have had hundreds of the galls, but have not as yet succeeded in rearing the gall-fly. The galls are mostly always infested by a species of guest-fly, which cause the larvæ of the gall-maker to succumb before reaching maturity. The gall-fly is known only by a single female, in the United States National Museum.

Compsodryoxenus *Ashmead.*

Compsodryoxenus Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 129; Psyche, Vol. X, 1903, p. 155; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 78.

Head and thorax closely, confluently punctate or slightly rugose. Antennæ filiform, 13 or 14-jointed, third to sixth joints nearly of equal length, those beyond gradually shortening. Parapsidal grooves delicate, but distinct. Scutellum cushion-shaped, separated from the mesonotum by a transverse groove. Pleuræ punctate. Abdomen compressed, ventral valve very prominent, pointed, plow-shaped. Wings with the vein at base of marginal or radial cell arcuate and surrounded by a brown cloud; margins of basal vein clouded and a brown spot before the break in the anal vein. Claws entire.

Type: *C. maculipennis* Ashmead.

Compsodryoxenus maculipennis *Ashmead.*

Compsodryoxenus maculipennis Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 129; Psyche, Vol. X, 1903, p. 155; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 78.

Female. Head brown, cheeks pale yellowish brown, closely punctate, somewhat rugose. Antennæ 14-jointed, pale yellowish brown, reaching the base of the abdomen. Thorax brown, transversely rugulose or closely and confluently punctate, parapsidal grooves fine and distinct, lateral groove distinct. Scutellum rugose. Abdomen brown, compressed. Legs: middle and posterior tibiæ and femora brown, remaining parts pale yellowish brown. Wings hyaline, veins brown, margins of basal vein a spot before the break of the anal vein, and a large blotch at the base of the marginal cell, including its basal nervure, brown. Length 2.6 to 4 mm.

Gall. On twigs of live oak (*Quercus* sp.) Polythalamous. Irregularly rounded or elongate, hard woody swellings, very much like that of *Andricus coxii* Bassett.

Habitat: Arizona.

The types are in the United States National Museum.

Compsodryoxenus brunneus *Ashmead.*

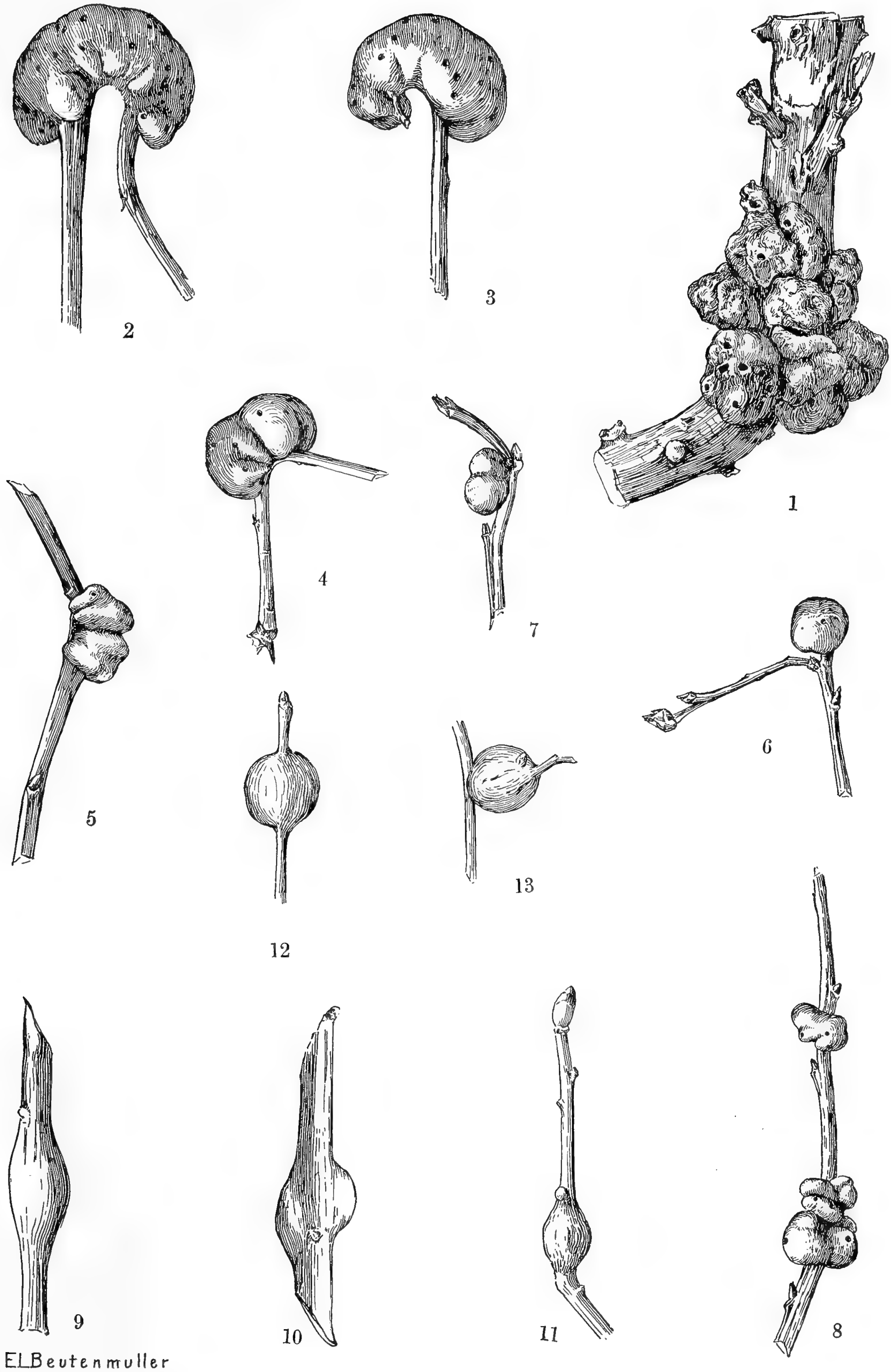
Compsdryoxenus brunneus Ashmead, Proc. U. S. Nat. Mus., Vol. XIX, 1896, p. 129; Dalla Torre and Kieffer, Gen. Ins. Hymen. Fam. Cynip., 1902, p. 78.

Female. Head, antennæ, thorax and legs pale or light brown, the antennæ toward tip dusky, the pleuræ blackish, the abdomen black, polished, the posterior legs dusky or darker than the others. Wings hayaline, marked as in *C. maculipennis.*

Gall. (Plate LI, Figs. 9–13.) On the branches of oak (*Quercus chrysolepis*). Polythalamous. Very hard, ovate or elongate woody swellings.

Habitat. California.

The types are in the United States National Museum.



1. *Belenocnema treatæ* Mayer. 2–8. *Solenozopheria vaccinii* Ashm.
9–13. *Compsodryoxenus brunneus* Ashm.

56.6:07

Article XXIII.—MODERN LABORATORY METHODS IN VERTEBRATE PALÆONTOLOGY.

By A. Hermann, *Chief Preparator*,

Department Vertebrate Palæontology, American Museum of Natural History.

Plates LII–LVII.

The brief description which I read before the society of Vertebrate Palæontologists at New Haven, Conn., in December, 1907, published in the 'American Naturalist' for January, 1908, under the title, 'Modern Methods of Excavating, Preparing and Mounting Fossil Skeletons,' was of necessity but a very sketchy outline owing to the time limit allowed each paper. Through the courtesy of Prof. H. F. Osborn, President of the American Museum of Natural History and Curator of the Department of Vertebrate Palæontology, under whose general direction the work of our laboratory is conducted, I am now enabled to present a more detailed description of the latest and most practical methods for general use in a vertebrate palæontological laboratory.

Primitive Laboratory Work.

As much as forty years ago Professors Marsh, Cope, and Leidy had prepared vertebrate fossils, in this country. This was done mainly with a view to description and identification, and the work was carried out in a rather crude manner. The bones were cut out of the matrix in the simplest way with poor tools, and as they came out in pieces they were cemented together with common carpenter's glue. This held them together only as long as the glue retained some moisture; they fell apart just as soon as the glue became dry. This, however, may not have been the case in every palæontological work-shop but certainly it was so in most of the American ones.

During later years much experimental work has been done in connection with field and laboratory methods, and my object in this paper is to explain in detail "the best results which we have yet been able to attain," and the present practice in the American Museum and other laboratories of Vertebrate Palæontology.

Field Work.

I have already stated in my preliminary paper that it was not my intention to give any instructions in reference to collecting fossil bones in the field, for the reason that I have not myself done much along this line. However, having been engaged as preparator for the past thirty-two years — sixteen years with the late Professor Marsh at New Haven, Conn., and over sixteen years in my present position under Professor Osborn — I take this opportunity of demonstrating from practical experience what method of treatment and preservation in the field I have found most practical and reliable for giving the best results in the museum laboratory.

In the early day of fossil collecting in this country, some fifty years ago, the bones were simply taken up, as Professor Marsh termed it, "in potato fashion," that is to say, the fossils were dug out of the ground where they were discovered in the same rough manner that potatoes are dug in the field. They were picked up in pieces, done up as far as possible in parcels in the order in which they had been taken up, and then left to the preparator in the laboratory to fit the fragments together again.

Joining the pieces together, however, was in a great many cases an utter impossibility, especially if the pieces were quite small and the fractures not characteristic enough to determine their position. This method fortunately has been gradually replaced by a better one, which is the result of the cumulative experience of a generation of fossil hunters; this is the method of "bandaging" the bones before taking them out of their place in the field. The collectors for Professors Marsh, Cope and Osborn, including the late Mr. Hatcher (who to my knowledge was the inventor of the "bandage" method), Mr. O. A. Peterson, Dr. J. L. Wortman, and later Mr. Barnum Brown, Mr. Walter Granger, Dr. W. D. Matthew, Mr. Albert Thomson and others, used muslin or burlap which is soaked in raw flour paste and applied to the bones in the field. (Any kind of coarse, loose-woven cloth, old burlap, bags or sacks which have been used for grain or potatoes, are easily obtained everywhere and are excellent for the purpose.) The cloth is well soaked in the paste and applied to the bones in the same manner as to wall paper. When dry this paste holds the fragments together so that the specimens can be packed and shipped securely.

The muslin should in nearly all cases be applied close to the bones and if great strength is required, as in the case of very large bones, burlap may be pasted over this. Even greater strength than this can be obtained by the use of plaster of paris instead of flour. The "bundle" may even be reinforced by the use of iron rods or strips of wood, whichever may be obtainable.

Whenever plaster is used to hold larger blocks together it is generally desirable to have a thin layer of paper (tissue or parafine paper preferred), between the bones and the plaster, to avoid the binding of the plaster to the specimen.

Paper should also be applied to the cloth when a plaster jacket over the cloth becomes necessary, as this saves a great deal of labor in the laboratory in freeing the bones from the bindings. The paper is applied by first moistening the surface of the bone with gum water or shellac, then laying on the paper and pasting it down with a wet brush. When flour paste is used it is

Fig. 1. Bandaging *Brontosaurus* bones in the field.

nearly always desirable to introduce a small quantity, of a solution of corrosive sublimate, say a half grain to a quart of paste. This keeps the paste from fermenting, and poisons the latter so that the mice will not eat the bandage. A few words may be added in regard to the treatment of the bones before lifting them from the ground.

As stated in my previous brief paper it was customary in earlier days to use a thin solution of gum arabic for soaking the softer and more porous bones in order to harden them for packing and transportation. This was practical for very porous and soft bones but the gum did not penetrate deep enough into hard and less porous bones, so that they remained rather crumbly

inside. Gum when dry becomes very brittle and by absorbing the dampness of the atmosphere freely loses its binding power.

Through the experimenting of the various collectors of the museums in America, it has been found that shellac is in nearly all cases superior to gum. It is absolutely waterproof and penetrates much more readily into the soft and partially decomposed bones than gum; and when sufficiently dry, makes the bones far more resistant. Denatured alcohol is most generally available, but wood or grain alcohol penetrates a little better and dries faster. To prevent discoloring of the bones, white shellac should be used for light colored bones, while common brown shellac is preferable for dark bones, as it dissolves much more easily than white shellac.

Some European collectors use hot glue water for hardening the bones and matrix. This penetrates well and hardens well but has the disadvantage of softening up in damp weather and makes the preparing and restoring in the laboratory much more difficult, since glue acts as a retarder to plaster.

No standard rules, however, can be prescribed as to the manner of treating different bones. This must be left entirely to the judgment and experience of the collector. A good collector's work always meets with the sympathy of the preparator, while on the other hand the work of a poor and careless collector creates ill feeling between the latter and the preparator, not to speak of the damage done to specimens and the valuable time expended in the work of preparation.

In closing this subject I should also like to mention that it is a great fault on the part of some fossil collectors to free the bones too much from the matrix, for this weakens the specimens and makes them more difficult to transport. Unless the matrix is very soft and loose, as, for instance, sand, loose clay, etc., sufficient matrix should be left on the bones to insure safe transportation, and it always pays to ship a few extra pounds of rock, which can be easily removed in the laboratory, as this preserves the specimens intact.

When large blocks containing dislocated skeletons had to be taken in sections I always found that if the collector had made a careful diagram, on which the respective sections were marked and numbered, it would be of great help to the preparator and of immense scientific value to be able to place the parts as they were found. I have found in my experience that some collectors do not pay attention enough to the packing and the labeling of the different parcels. This is one of the most important parts of collecting and should never be neglected.

It is always a pleasure for the preparator to handle specimens well preserved and carefully labeled in the field, and the time saved in preparing

and piecing together such specimens pays well for the careful treatment and labeling by the collector.[1]

I have said more about field work than I intended to say, but while the skilled and experienced collector needs no advice, yet such advice may be of much use to the inexperienced beginner.

Laboratory Work.

Unpacking.— The unpacking of bones containing palæontological specimens should be done systematically. To pack a box well, the specimens should be placed in such a way that enough space is allowed for sufficient packing material, straw, hay, excelsior, to be put between the single specimens or parcels, so that rough handling in transportation cannot injure the contents.

A well packed box or case should be unpacked carefully by removing the cover as easily as possible and then removing first the packing which holds the packages in place, so that the parts may be taken out freely. It is of great importance to look over the labels and keep the parcels or parts of bones as much as possible together in trays. If one parcel contains several other small ones in which the smaller bones or parts of bones are wrapped up singly, as is often the case in taking up feet, ribs and parts of skulls, it is always advisable to keep the contents of each little package separate, but to keep the associated packages together in a larger tray. This method is time-saving later on in piecing the broken bones together. The most important thing in packing is to save the field labels. A good collector always labels his specimens with date and locality on every main parcel or bundle. It is the duty of the preparator to save these labels, that is to remove them

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[1] A valuable suggestion has been made by Dr. W. D. Matthew, which I desire to quote: "Collectors should keep in mind that the expense and time of preparation usually far exceeds the entire cost of collecting specimens in the field. In the experience of the larger museums, a great part of the collections sent in year by year is stored away unprepared and useless for study or museum purposes and with little prospect of its ever becoming available. The more choice, more complete, or better preserved specimens are naturally taken up first. The rest of the collection goes into storage and too often remains there indefinitely. Collectors therefore who desire to see their collections prepared, studied, and placed on exhibition promptly, would do well to send in only the best and most easily prepared of the specimens they discover to use every possible means to decrease the necessary time and expense of laboratory preparation and to avoid wasting time and effort in collecting poorly preserved specimens or those which are not of first class scientific interest or exhibition value."

However, this only applies if the collector is a man of sufficient scientific attainment to be able to judge of the scientific value of a specimen on the spot; for, as every palæontologist knows, it is sometimes a mere fragment, or some poorly preserved specimen which is of inestimable value from the scientific point of view, and it would be unfortunate to reject such material in the field for more showy though much more common specimens.

If the collector is ever in doubt about a poor looking specimen whether it has enough scientific value to be sent, the safest rule, in my opinion, is to take it along.

from the specimen if pasted on, before preparing, or cut them out of the wrappers and keep them for reference.

The unpacked bones, matrix blocks, etc., should never be crowded too much in trays, so that they are allowed to knock against each other; this will surely injure delicate specimens. Carefully unpacked and well-labeled specimens can safely be handled and when stored should be easily accessible.

Preparing of Bones.— The preparation of bones consists of:

1. Removal of the matrix, sandstone, clay-rock, etc. This is done with a variety of special tools, to be described later.

2. Piecing and cementing the shattered and broken bones together and strengthening them so that they can be handled or mounted. For this purpose a variety of cements are used and the bone is soaked with thin solutions to strengthen it.

3. Repairing and restoring missing parts of bones. All preparation of fossil bones is delicate work and requires the utmost care, and in most cases skill also.

Freeing the bones from the bandage.— All bandages, especially those applied to the surface of the bones, should be removed very carefully by slowly wetting the paste with a sponge, allowing the bandage to become soft enough to be pliable. In pulling the cloth loose from the bones, care should be taken that loose fragments on the surface or other small pieces do not drop out of place. I find it usually advisable to replace the loose fragments at once so as not to lose them. Well preserved bones and those that are hard enough to handle, may be taken loose from the bandage and the pieces cemented together, but in the case of badly broken and weather-cracked specimens, such as crumbly bones, it is desirable to remove the bandage of one side first; then after the bone is soaked with shellac (if such is necessary) and the loose pieces fastened and the fractures filled in with plaster, a plaster bed should be made on the exposed side and the specimen turned over, to be manipulated similarly on the other side. Wherever a plaster layer or bed is needed to turn over a specimen of any kind, a thin layer of paraffine paper or a coat of lard oil should be applied to the surface of the bone to prevent the plaster from sticking fast.

Cutting the Bones out of the Matrix.— Well preserved and hard bones can be freed from the matrix with comparative ease, as they will stand the jar and blow of a hammer and chisel without injury, but a soft and crumbly bone, on the other hand, requires much care and patience, especially if the bone is imbedded in more or less hard rock. By frequently applying a solution of shellac or gum to the bones as the surface becomes exposed, it will toughen and harden the specimen, if time to dry is given, so that a very soft and crumbly bone becomes strong enough to be handled safely. I have

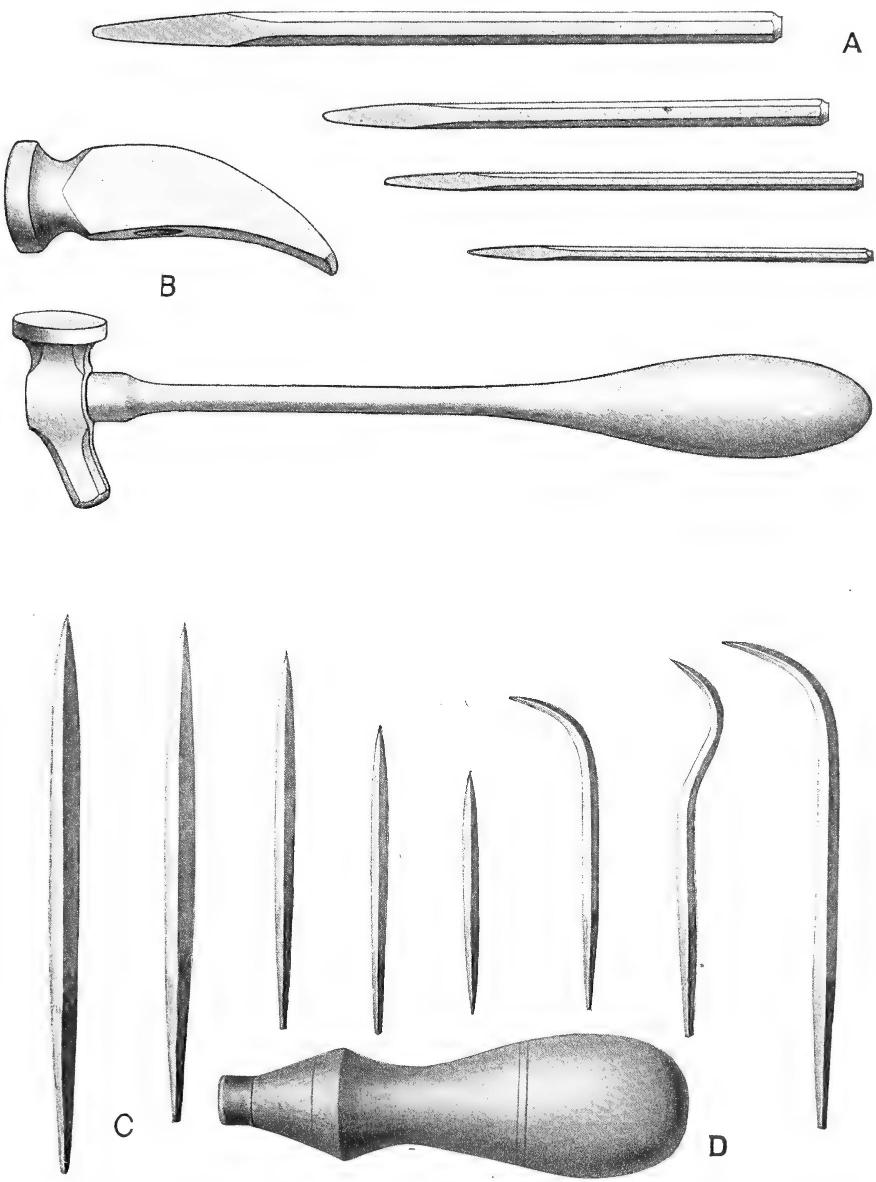

Fig. 2. A, B, chisels and hammer; C, D, awls, used in removing matrix. A little over one half natural size.

seen in the American Museum bones of great scientific value so crumbly that they could almost be blown away, which were treated with great care in this manner and looked almost as well preserved as perfect specimens.

The tools for cutting rock should vary according to the size and condition of the specimens. For small bones a light hammer and a small, narrow pointed chisel should be used (Fig. 2A), while for larger bones and hard rock a comparatively larger chisel and heavier hammer should be employed. The selection of tools, as to strength of the blow, etc., must be left to the judgment of the preparator. As a practical hammer I find the shoemaker's hammer, which can be obtained of different sizes (Fig. 2B). Sand bags

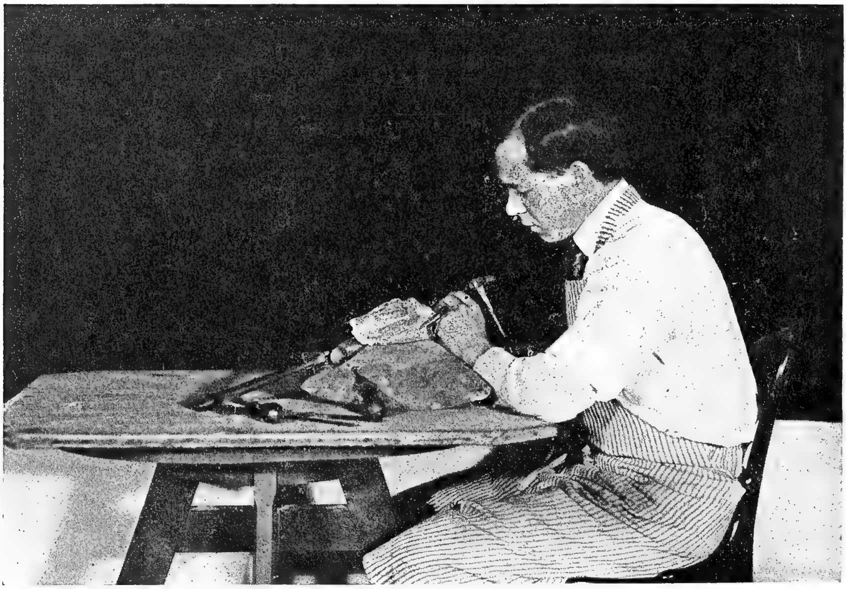

Fig. 3. Freeing bones from the matrix; use of the sand bag.

of different sizes employed as bedding for the specimens from which the matrix is cut off, are very practical for all specimens of moderate size (Fig. 3). The pneumatic hammer, such as that in use in stone cutters shops, is not of much value for heavy cutting, since the large hammer that is required can scarcely be operated with sufficient care, but the system may be recommended for light and delicate chiseling, as, for example, around the edge of the bones, as this is less injurious in such cases than chiseling by hand, provided a very light hammer is employed.

When larger, thin, flat bones are cut out of hard rock, such as scapulæ, pelves or parts of skulls, care must be taken that the specimens are solidly

embedded on one side, while the matrix is being chipped off on the other, so as to prevent shattering; and a plaster bed should always be applied, if necessary, to prevent the bones coming apart. The delicate edges and the thin walls of the bones should be freed from the rock with great care. Whenever the bones can be traced under the rock, I have found it advisable to use as large a hammer and chisel as possible, to cut the large mass of rock off rapidly, but on approaching the bones greater care must be exercised, and the size of the chisel and hammer must be reduced so as to avoid all injury to the bones.

In my experience I find the so-called "crooked awl" (Fig. 2, C, D) made from the harnessmakers' or saddlers' awl, which can be obtained in all sizes at any harness maker supply store, a most practical and convenient tool, for removing from specimens all kinds of matrix of not too hard a character. This awl can be bent to suitable shapes and tempered and sharpened for hard and soft matrix, and is an indispensable tool for all palæontological field and laboratory work. As far as I know it was introduced by Prof. Marsh over thirty years ago and is now used in most palæontological workshops. After being heated to a cherry red and dipped in water the temper should be drawn over the curve a dark straw color, almost bluish, so as not to break off.

I may mention another tool which I find of great service, namely, the plumber's shave hook (Fig. 4, A). This, as well as the curved awl, serves as a scraper in scratching off soft matrix paste or plaster from the specimens, and both are also very useful in plaster work.

Many years ago we introduced into our laboratory the dental lathe with two sizes of flexible arms attached (Fig. 5). This little lathe of about $\frac{1}{6}$ horse power can be attached to any incandescent lamp block. Small size (up to 6 in. diameter) carborundum wheels can be used for grinding hard rock off the specimens; and with the flexible arm attached, which holds the smaller wheels also, it enables the preparator to grind hard rock off the specimens where a chisel could not be used with safety. Small rotary brushes (wire or bristle) may be attached for cleaning out cavities in the bones which otherwise could not be reached with ordinary tools. It also carries a drill chuck large enough to bore a $\frac{1}{4}$ inch hole in iron or bone.

For very light and delicate work, such as cleaning small specimens, teeth and small skulls and all fragile bones we have used with the smaller flexible arm the regular dental burrs such as are used by dentists, which enables us to remove not too hard rock from very delicate bones and teeth without injury to the specimens.

The regular dental engine is also employed in our laboratory for these purposes. This method is rather slow but is the one least dangerous to the specimens, and I can recommend it for all extremely delicate work.

We have also employed the "dental mallet" for very delicate chiseling. This instrument is an electric plugger such as dentists use in filling teeth. We had a large size constructed especially for our purpose which works well on all small specimens. The only disadvantage is that the mallet gets

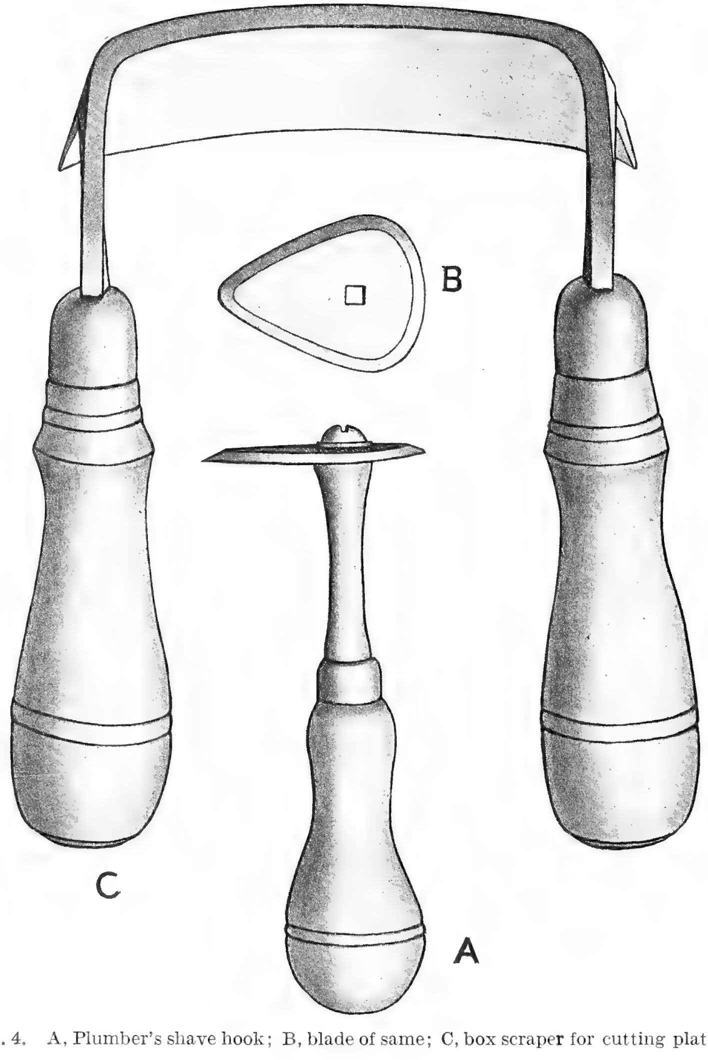

Fig. 4. A, Plumber's shave hook; B, blade of same; C, box scraper for cutting plates.

out of order too easily in the hands of a man unacquainted with electrical appliances.

Wherever compressed air is installed, the sand blast may be of great help

in freeing the bones from their matrix. On very hard matrix however it produces but little effect. It can only be applied to specimens where the bone is considerably harder than the matrix.

We have also employed chemicals for freeing fossils from matrix which was so hard that steel tools, such as chisels, awls, etc., were of little use. If

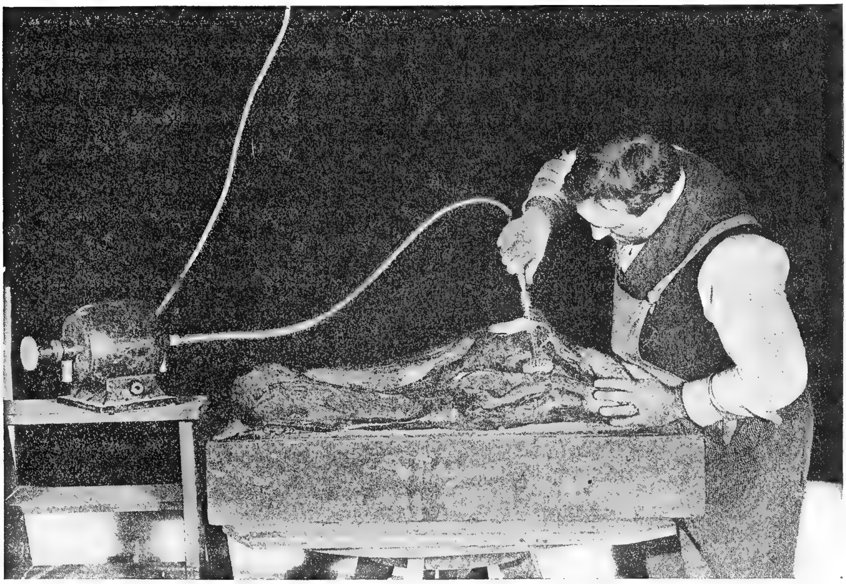

Fig. 5. Dental lathe, with brush on flexible arm.

the matrix contains lime in any form, hydrochloric acid will soften it and allow the chisel to take hold; on matrices of other composition caustic potash may be of some help. These chemicals, however, should be applied with great care as in many cases the fossil as well as the matrix is attacked.[1]

[1] Dr. F. A. Bather of the British Museum of Natural History has published in the 'Museum Journal' for September, 1908, an article entitled "The Preparation and Preservation of Fossils," in which he discusses among other things the chemicals used in freeing fossils of all kinds from their matrix. I here quote his suggestions, which I consider of great value. After describing various methods Dr. Bather continues:

"In applying several of these methods I have received the greatest help from Mr. Walter F. Reid . . . . Chairman of the London Section of the Society of Chemical Industry. . . . Since the action of these differentiating solutions is slow and often uncertain, Mr. Reid has devised the following ingenious method, which may be applied to any fossil of which the matrix contains carbonate of lime, either as the main constituent or as a cement. Assuming that a small portion of the fossil is exposed, this is painted with a protective solution. For this purpose Mr. Reid has a special solution of cellulose in amyl or ethyl acetate made flexible by the addition of castor-oil (I cannot give the precise formula). Instead of this, one may use an alcoholic solution of 'Brillac,' which is a synthetised shellac of exceptional hardness quite recently placed on the market.

Piecing the Fragments Together.— The piecing of the broken bones is a very difficult problem and requires a great deal of patience as well as knowledge of the form of the bones. A preparator who loses patience easily and is of a nervous disposition will never make a good fragment piecer. Some preparators take a quantity of broken bones, lay them out on a table and begin by trying to fit every piece within reach to the piece held in the hand, in the same way as one would try to put together a "Chinese puzzle." This method is not conducive to the best results.

I will take this opportunity to illustrate the system that I learned from Prof. Marsh, more than thirty years ago. When fragments have been picked up lying loose, by the collector, that is, such fragments as have been isolated or washed away from their proper association, so that the remains of a number of bones have been mixed up together, it is always a good plan, to select those pieces that can be identified as belonging to a certain bone and keep them together; also those that show their near relation, by their shape, or characteristic fracture. Pieces from the edges of the bones, pieces of skulls, of vertebræ, of limb and foot bones, should be kept together in separate spaces or in shallow, pasteboard trays, so that if the preparator works on piecing a skull, he will not be wasting time in handling the pieces of vertebræ or even of limb bones.

Before beginning to put pieces together all fragments, if hard enough, should be washed clean so that the fractures can be seen distinctly. This is of great help in finding contacts.

Some of the most important specimens, some of them of immense value to science, have been pieced together from hundreds of fragments, the opera-

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" A solution of pure shellac would no doubt serve if Brillac could not be obtained. The exposed portion of the fossil being thus coated with one or other of those solutions, the specimen is suspended in an acid called hypo-acetine. This partly dissolves and partly softens the matrix according to its greater or less calcareous constitution. After a period varying from half-an-hour to twenty-four hours, according to the nature of the matrix, the specimen is taken out, washed in pure water, and allowed to dry. The softened matrix is then removed with a brush of bristle or horse-hair. Any freshly exposed portions of the fossil are then coated with the protective solution and the whole suspended in the hypo-acetine. The process is repeated indefinitely until the whole of the matrix is dissolved and brushed away and the complete fossil exposed. The protecting collodion may then be removed by acetone or ether-alcohol.

" After being used for some time the hypo-acetine loses its power. One then adds to it a 'restoring solution,' which precipitates the limestone and restores its original virtue to the hypo-acetine. . . .

" It may, of course, be possible to use other acids such as hydrochloric or acetic, but the hypoacetine which is the result of considerable experiment, seems to have a more equable action. This process is particularly suitable in the case of bones, which being of phosphate of lime, are not so readily attacked by the acid as is the carbonate of lime in the matrix. I have, however, used it for fossils of pure calcite.

"Some matrices containing little or no carbonate of lime are not attacked by hypo-acetine or similar acids; such for instance are slates and the purer shales. These and other silicates, or even pure silica such as sandstone, require other treatment."

tion often taking days and weeks of patient and conscientious effort on the part of the preparator. It is always taken for granted in such cases that the collector has gathered all the pieces that could possibly be found.

Cementing Pieces Together.— The substance or cement used to fasten the fragments together is of various kinds and qualities. To my mind it is very important to know which is the best cement for a given kind of piecing. As mentioned at the beginning of this paper, in the early days ordinary carpenter's glue was used with poor results, later on I have myself used a mixture of carpenter's glue and plaster, which held a little better, if applied properly but this had the disadvantage of becoming soft and rotten in a damp place.

A preparation, which the late Mr. Jacob Geismar introduced (as far as I know, a composition of carpenter's glue soaked in very little water and then cooked with linseed oil) was a pretty fair cement; but it did not have enough binding power, and was more or less subject to decomposition when too old.

There are also a number of cements mentioned in technical books, especially in those treating of the different binding properties of cements, etc. Some of these may be useful for different classes of work in a palæontological laboratory but their manufacture is so tedious and difficult that the material employed and time spent make it too expensive for use in large quantities.

There are different kinds of cement on the market used for cementing porcelain and crockery which we have used for years past in cementing together very small and hard bones such as teeth, little foot bones, etc., with the best result, but for large bones these cements are impractical not alone on account of being too expensive but also because it would take too long for the bones to become dry. Any kind of cement which takes much time and experience to mix, is impractical for a large "bone shop."

We have introduced in our laboratory a very simple and easily obtainable cement, which answers almost every purpose. This is a mixture of alabaster plaster with a solution of the best gum arabic, which makes a very powerful cement for fastening small as well as large pieces together. The gum is dissolved in hot water (one pound of gum to 3¼ quarts of water) mixed well with the plaster to a thick cream, and applied to both fractures, which must be absolutely clean and free of any greasy substance. Done in the proper manner, this cement holds the fractures firm and I can show bones here which were cemented with this composition at least fifteen years ago and which now if handled roughly would break in a new place, but not in the line of joining.

Another good cement for hard bones where the fractures are smooth can be made by mixing prepared glue or so called fish glue with fine plaster.

The glue should be thinned down somewhat with water say to about half its strength and mixed thoroughly with plaster to a thick cream-like consistency; if enough plaster is mixed in this makes a very powerful cement much stronger than gum and plaster; but it does not hold very well in damp places since it absorbs moisture very freely. In dry rooms on the other hand it will last very well.

The plaster cement should be mixed afresh every time a small number of breaks is to be mended and applied to the broken surfaces, which are then pressed tightly together and the bone set up in a tray of loose sand, or on a piece of modeler's clay until the cement is well set. To mix cement in small

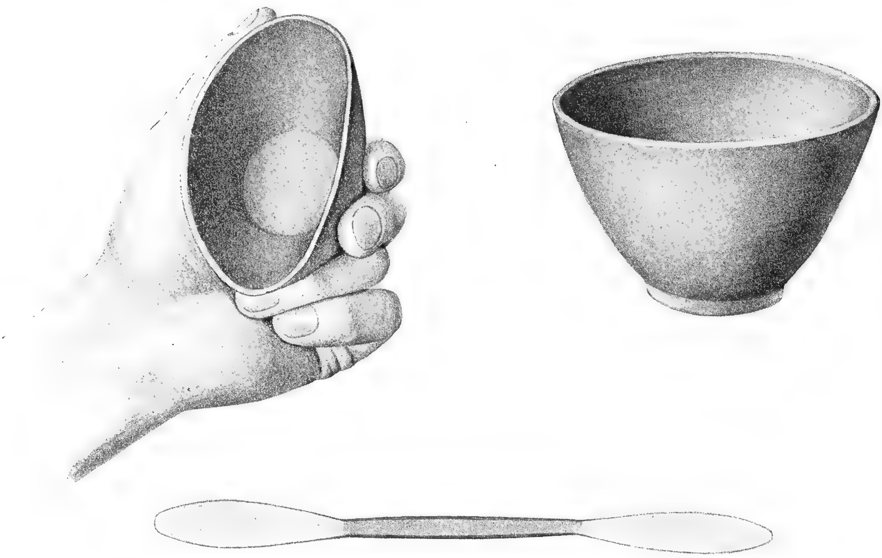

Fig. 6. Rubber cup and spatula.

quantities I find the rubber cup, such as that used by dentists, very practical, since it can be cleaned so easily by squeezing the cup when the plaster has set which allows the hard plaster left to drop out (Fig. 6). It depends largely on the skill and conscientiousness of the preparator whether the bones hold together or fall apart when touched. When a bone can be bored with a steel drill which is the case with a great many bones, an iron rod or wire should be inserted and imbedded in plaster to hold the parts together.

Restoring the Bones.— The restoring of missing parts of bones requires a great deal of skill and not every preparator becomes perfect in this line of work.

To my mind it is necessary in the case of a good many poorly preserved

bones to restore the missing parts, in order to preserve what there is, as, by frequent handling, the fractured parts will crumble away until nothing remains. When larger parts of a bone have to be reproduced, it is important to have the restored part attached properly to the bone part so as not to become loose; therefore wherever possible, holes should be bored and wires inserted in the bones on which the plaster can get its hold; and wire netting of the proper size or other wires should be fashioned to the shape of the part to be restored and imbedded in the plaster. This will make a much stronger restoration and if it becomes cracked it will not fall apart.

In restoring work I find modeler's clay ("plastiline") a great help in building up walls to hold up the soft plaster or for rough molds to hold the plaster until it becomes set. For all restorations we almost exclusively mix the alabaster plaster with a solution of yellow dextrine, about one pound pulverized dextrine to three quarts of water. Dextrine dissolves very readily in boiling water. This mixture has about the color of light coffee and when mixed with plaster of the consistency of thick cream, sets very slowly (in about fifteen to twenty minutes), a fact which is of importance in building up the restored parts.

In former years we used mostly gum arabic for restoring as well as for fastening pieces together, but we found that the plaster mixed with gum is much more brittle than that mixed with dextrine, as the latter contains some sort of a starchy substance, which makes the plaster decidedly tougher than that mixed with gum. I have also used dextrine in fastening pieces together although it has not the binding power that gum has, and I would not therefore recommend it for this purpose.

In order to make the plaster set more slowly than dextrine-mixed plaster ordinarily would, a few drop of a very thin solution of gluewater (made of liquid glue) added to a pint of water, will keep the mixture from setting for over twenty minutes. Plaster mixed with gum sets almost as fast as plaster mixed with pure water, and if necessary to keep it from setting for ten or fifteen or twenty minutes, as may be the case in piecing bones, a little larger dose of glue water may be added as with dextrine, but too much glue lessens the strength of the plaster and all plaster should be allowed to set within thirty minutes.

Gum-arabic and dextrine in solution both help in hardening and toughening the restorations and it is advisable in all cases when the restoration is dry, to soak the plaster parts in the same solution employed in mixing the plaster.[1]

[1] Mr. F. A. Lucas, Curator of the Museum of the Brooklyn Institute of Science and Art, recommends mixing with the dry plaster althea (marshmallow) root in pulverized form, and he reports very good success as to strength and toughness of the plaster. I have given this a fair trial and after some experimenting I find that althea is in some respects equivalent to dextrine, with the exception that it retards the setting of the plaster somewhat less.

Coloring of the Plaster.— For coloring plaster mineral colors are preferable, such as yellow ochre, raw and burnt sienna, raw and burnt umber, earth green, and drop or bone black, the last not a mineral color. All these colors must be ground as fine as possible, and mixed in powder form with the dry plaster. To produce a bluish color in plaster black may be used; for a chocolate color raw and burnt umber and black; to produce gray I generally use black, yellow and a small quantity of raw umber and very little green; black and brown mixed with plaster give a blackish color. All variations in color can be obtained with the above mentioned colors, after a little experimenting.

It should be mentioned that all colors especially brown and black, when mixed with plaster in larger quantities either dry or in solution, weaken the mixture to some extent, and therefore in all cases, where much coloring matter is used, the solution used for mixing the plaster whether gum or dextrine must be proportionately stronger. Too strong a solution, however, makes the plaster crack, and this is the case with either gum or dextrine.

If the coloring material becomes lumpy, which is often the case, it should be pressed through a fine hair sieve, before mixing with the plaster, to prevent the mixture looking streaky when set. In repeating the mixing of colored plaster for the same specimen, which becomes necessary in restoring bones or in making large plaster mountings the mixture should be always of the same consistency (say of a thick cream) to avoid different shades in the plaster when set and dry, as otherwise the shades will vary, even if the same solutions and the same plaster is used.

Any preparator will soon become familiar with the above method after some experimenting.

Mr. Lucas has taken the formula from the 'Scientific American' and I reproduce it here.

"For retarding the setting of plaster, an addition of four to eight per cent. of althea (marshmallow) root powder produces a plaster that sets very slowly. The dry plaster is mixed with the pulverized root and the whole kneaded with forty per cent. of water to a paste. In consequence of the large proportion of pectine contained in the marshmallow root (fifty per cent.) we obtain a mass resembling a rich clay, which does not set until after an hour, and is then so hard and tough that it can be filled, turned and bored, and which can be employed for many purposes besides plaster casting. In a mixture of gypsum with eight per cent. of powdered marshmallow root, the setting is protected for a much longer period and the toughness of the mass increased. It can be spread, with the aid of a beetle on glass surfaces in large, thin sheets, which will not break when dry, are easily detached from the glass and by simple rubbing acquire a high polish. Where ochres and other coloring substances have been incorporated with the mass, it can be made, by proper kneading, to produce very fine imitations of marble. It can also be tinted after drying, with colors dissolved in water and afterwards made waterproof by soaking in linseed oil, varnish and lacquering or polishing. The locksmith can greatly increase its hardness, by mixing with it his iron filings, the picture-frame maker will never have any occasion to fear the cracking of his wares; according to its fineness and purity the gypsum will require a slight percentage more or less of water, which makes it impossible to define the exact quantity to be used. For many purposes it is nct necessary that the marshmallow root powder be of the finest quality."

Casting Bones, Etc.

Casting is a trade of its own and must be learned like any other. I do not wish to go into details about it; in a general way, however, a short account of the methods of casting employed in a palæontological workshop may be of interest, and I take this opportunity to discuss a few of the most customary processes.

In the American Museum a great deal of casting is done especially in the line of reproducing unique specimens, such as foot bones, skulls of rare forms and to a great extent also in the casting of restorations or models. I may mention that these casts are mainly made for the purpose of exchange with other natural history museums for study and a catalogue of such reproductions is issued by the museum.

The casting in our laboratory is done in various ways depending upon the character and form of the object to be cast. In making moulds for feet, especially for those mounted on plaster pedestals, also for skulls of all sizes, and for other light and delicate bones, we use the gelatine mould.

The gelatine I refer to for this work is a composition of the best French white glue soaked in water and thinned down with glycerine. The more elastic the glue is when dry, the better for this purpose; if possible it should be in flakes. The composition should be mixed according to the objects cast. For light and delicate casting where a very flexible mould is required, more glycerine should be used since it increases the flexibility and at the same time keeps the mould from shrinking too much, which is the case with a mould composed of glue only, when kept in operation longer than two or three days.

Glue moistened just enough so that it may begin to boil and then gradually thinned down with glycerine to the proper consistency will make a very elastic composition, useful in making casts such as those of brain cases where it becomes necessary some times to pull out the cast through the foramen magnum. However, the less glycerine used in a mould the better will it preserve during the process of casting, for the glycerine tends to make the mould soft and less capable of standing heat from the cast than a solid glue mould. It is therefore better for all large moulds in which the gelatine part of the mould can be an inch thick, to use glue only, cooked with water very slowly to a consistency that will allow it to run freely. The less water used, the stronger the mould. In our laboratory we have turned out as many as thirty casts from one glue mould; but this is an exception and the number varies generally between fifteen and twenty.

It is impossible to teach how to cast through mere explanation. This process is only to be learned through practical work, although a few words may be said regarding the process of preparing the mould.

Moulding.—If large objects are being cast a composite of pieces and glue-mould may be practicable, that is to say, all more or less even and smooth parts of the specimen may be moulded in plaster, and the rougher and more uneven parts or those which would be difficult to free from the specimen should be moulded in gelatine and the whole should then be held together by a plaster shell. How to arrange the different parts of the mould, so that they can be lifted off individually, must be left to the operator.

A combination mould is readily adaptable for the casting of large skulls where the portions around the teeth and other delicate parts may be moulded in gelatine. This reduces the number of pieces in the mould very much.

The specimen to be cast should first be given a thin coat of shellac to prevent the oil or other substances penetrating into the bone. It may then be embedded in clay to half of its circumference, that is, if the mould is to consist of two pieces only; if composed of more than two pieces, as may be often the case, the imbedding of the specimen should be arranged in such a way, that the parts of the mould resting on the imbedding can be lifted off freely; this should be the case in plaster as well as in gelatine moulds.

In gelatine moulding more than three or four pieces to the mould are very seldom required (large skulls excepted), on account of the elasticity of the gelatine; however, the parts must be arranged in such a way that they can be held together firmly by the outer plaster shell. But this matter is soon learned after a little experience.

The preparator should always be able to judge the strength and thickness of the gelatine required for a certain piece of moulding, considering the flexibility required as of great importance.

It often happens that in order to get the gelatine mould out of a deep cavity, it becomes necessary to use a wedge shaped plaster block, applied to the deepest part of the cavity allowing a thin sheet of gelatine between the plaster and the surface of the specimen so that, in removing the block, the gelatine can be loosened freely.

The thickness of the gelatine can be ascertained by rolling out a sheet of soft potters'-clay to the thickness required, and applying it closely to the specimen. The latter should be first covered with a sheet of thin paper to prevent the clay from sticking to it.

Now the plaster jacket should be cast over the clay and when set, it should be lifted off, to allow the removal of the clay. The shell may then be put back in position and the space left by the clay, filled with gelatine (Fig. 7). One or more air holes must be left in the shell to allow the air to escape as the gelatine forces it out.

When the glue mould is cold enough, so that the shell may be removed, one or two coats of a fully saturated solution of alum should be applied to the surface of the gelatine mould. This makes the surface tough and gives it more resistance to the heat produced in casting. This application of alum may be repeated several times.

Plaster Moulds.— All large bones, such as limb and foot bones, for instance, of dinosaurs or large mammals, large vertebræ that have no thin walls or cavities and all bones with even surfaces, in which case the moulds

Fig. 7. Pouring gelatine into mould.

may be composed of a small number of pieces, should be moulded in plaster. This sort of moulding requires more time and skill, but when a large number of casts are to be taken, it pays for itself in the end, since an almost unlimited number of casts can be taken from such moulds.

The different parts of the plaster mould must be carefully arranged in such a way that each piece can be loosened easily from the specimen to be cast, and the parts should be cut and notched, so that they reinforce one another by interlocking, so as to stay in place when the specimen is taken out of the mould. The whole must be held together by the outer plaster shell, whenever one is necessary, so as to stand as one piece.

After the original is shellacked and imbedded in clay, as mentioned above, a coat of lard-oil or a mixture of stearine and kerosene oil, or some thinner oily substance (as the case may be with the smaller bones) should be applied to the specimens, and care should be taken that the pores of the bones are filled with the shellac, so as not to allow the oil to soak into the bones; sufficient covering of oil must be allowed on the surface of the specimen, as otherwise the mould will become fastened to the bone. Each individual plaster piece should be taken separately when sufficiently set, and a coat of shellac applied to it. As many coats should be applied as is seen to be necessary until the pores of the plaster become filled, and shine or gloss appears. The joints of the pieces must be oiled over the shellac cover to avoid sticking together. All plaster parts must be well shellacked; this applies also to the outer shells of gelatine moulds.

Casting.— Casting by means of a gelatine mould requires more care and skill than casting in a plaster mould, for the gelatine is very sensitive to heat, and certain kinds will even melt at comparatively low temperatures.

It may be stated again that all parts of the mould must be well oiled before pouring in the plaster, and care should be taken after the plaster has set and begins to feel warm that the mould is opened and the cast taken out before the gelatine can melt.

Casting in a gelatine mould can be done successfully only in cool weather, for in warm weather the gelatine becomes soft and loses its toughness. If it is unavoidable, and gelatine moulds must be used in summer, ice should be employed to cool the mould and ice water should be used in mixing the plaster. Some kinds of gelatine stand more heat than others, and the finest casts result if the gelatine is of the kind to allow the casts to set and cool within the mould.

In cold weather it is advisable to expose the filled mould to the cold air and to take the cast out of the mould when cold. This allows the mould to cool together with the cast and the mould will therefore keep its sharpness. After every cast the gelatine mould should be brushed off with fine French chalk ("soapstone") which removes the surplus of oil and other matters which tend to reduce the sharpness of the surface.

Casting in plaster moulds is done in the same manner. In all cases care must be taken, that the air on the bottom of the mould is allowed to escape. This safeguards against air holes in the finished cast. The plaster should be mixed thin enough to run freely into all cavities of the mould. For heavy casting the plaster may be used somewhat thicker than for light casting; the mould should be shaken gently so as to force the plaster into all parts of the mould.

A few words may be said about reinforcing the casts. All casts should be

strengthened by the use of iron rods, wire or burlap; and care must be taken that the wires are fashioned after the shape of the mould so as not to show on the outside of the cast. In delicate and thin casts it is practical to cover the shaped wire first with a coat of plaster, so that if the wire should become shifted in casting it will be sufficiently coated not to show.

Strong rods may be used in large casts, also in the heavy shells of the moulds. The latter can be made very strong and durable by laying burlap and wire gauze in sheets in them, while the plaster of which they are composed is still soft. The placing of the wires in the moulds must be arranged in a way to avoid shifting by the inpouring of the plaster.

Unless a uniform white is the color required in the cast, the plaster for all casting should be mixed with a thin solution of dextrine (about one pound of dextrine to two gallons of water). This mixture makes a much stronger and tougher cast than when the plaster is mixed with clear water; the mixture however darkens the plaster a trifle.

To increase the strength and durability of the casts the latter, when perfectly dry, may be saturated with a gum or a dextrine solution.

To make the casts damp-proof I recommend that they be allowed sufficient time to soak in a thin solution of shellac. The latter makes the casts and especially the surface, very hard. All casts, treated in this manner can be easily tinted and painted, since the pores of the plaster are closed.

A simple method of casting odds and ends and such objects of which only one cast is required — as may be the case in restoring missing bones — is that which we introduced many years ago in our laboratory as I have already mentioned very briefly in my preliminary paper; I now take the opportunity to explain this method more fully.

Modeling clay, such as that known under the name of plastiline, is of the greatest use in moulding such objects as those just mentioned; and where a not too accurate cast is required, it is a great labor and time saving method. The clay should have the proper consistency, neither too hard nor too soft. The clay block to be used should be of the size and thickness required. The bone to be cast must be coated thinly with glycerine to prevent it from sticking and then pressed with its median line into the clay, that is in such a way that the object can be lifted out of the mould without altering the impression. Before making the top half of the mould the bottom should be painted with glycerine to prevent the sticking of the two halves together and a few impressions or notches made with the finger where the top mould is fitted on, to aid in holding the two parts in position after the specimen is taken out.

In making the second half of the mould the clay should be pressed on the lower half in thin sheets to allow a good impression to be made, and when sufficiently strong, so that the mould will not lose its shape on lifting off, marks

should be made with a pointed tool over the edges where the two parts of the mould fit together, so as to enable the caster to bring the parts in proper position again after the object is removed. The plaster should be poured in the two moulds separately up to the edge of the impression, and when sufficiently set, so that the plaster does not run when tipped over, both moulds should be slowly pressed together until the marks of the two moulds fit accurately.

When larger bones are cast in this way it is often necessary to have the mould of three or more parts; and with some skill and care a fairly good cast can be obtained that is accurate enough for ordinary purposes.

To replace missing bones it is often desirable to make the cast larger than the bones from which the cast is taken. This can readily be accomplished as far as the circumference is concerned, by moving the bone a little in the impression to make the latter larger; and the length may be increased by cutting and stretching the shaft. Should the bone be in two pieces it pays to stretch it to the required length. In this way the two ends will be moulded pretty accurately, which is the main object in modeling, for the middle part, or shaft, can be shaped easily.

A number of small bones, such as foot bones, etc., can be cast together in a single mould, a process which saves considerable time.

The larger clay moulds can be stiffened by the use of strips of wood or with iron rods or wire.

For very accurate and sharp casting sulphur is often used instead of plaster. Sulphur produces a much sharper cast than plaster does and for all small casts is very desirable. The mould used in sulphur casting should be made of fine potters'-clay of neither too hard nor too soft consistency. The mould is prepared in the same manner as that made of plastoline, that is by pressing the specimen to be cast into the clay.

If more than one duplicate is required the mould should be constructed in a sufficient number of parts, so as to allow the casts to come out of the mould freely without injuring or changing the form of the impression. If several pieces to a mould are required, the separate parts should be treated in the same manner as in the case of plastiline that is where the parts join together, glycerine or turpentine should be applied to prevent sticking together.

To hold the parts of the mould in place, a light plaster shell should be applied to its outside. To produce a very sharp cast only a thin coat of oil (best turpentine) should be applied to the specimen to be cast.

Sulphur must be cast very hot, melted until it begins to smoke (not to burn) to make it run freely, which fact makes a plaster mould of no use since the sulphur would burn the plaster. The sulphur has to be poured in the mould in the same way as gelatine is, that is a hole must be left, and clay

should be built around in funnel-shape where the sulphur is poured in. Care should be taken that the pour-hole is placed so that it interferes as little as possible with the form of the object, as in all casting it is necessary to shake the mould slightly, to allow the air in the bottom of the mould to escape.

Several small casts can be produced from one mould at the same time, if a small channel between the separate specimens is cut out of the mould to act as a connection, and such should always be cut at a place where the least harm is done to the form of the cast.

As stated above sulphur produces a very sharp and durable cast, which can be colored to suit; and the sulphur cast is very good for casting any small specimens such as teeth, foot bones, and other small bones, where a very accurate cast is required.

Brain Casting.— It is often of great importance to science to know the size and form of a brain cavity, since many theories are more or less based upon the brain capacity of an animal; therefore it often becomes necessary to make a cast of the brain cavity. A few words may be said in regard to this kind of casting and how the best results may be obtained.

As I have mentioned on another page (p. 299) it has happened within my experience that for some particular reason a brain cast had to be taken out of the cavity through the *foramen magnum.* The brain however in comparison to the skull was a very small one, and the foramen magnum was relatively large. This is in any case a very difficult operation and should be avoided wherever possible, and therefore the brain case should be in several, or at least in two parts.

A skull, of which the brain case is to be cast, when broken in such a place that the brain case can be separated, even though in unequal parts, is often very suitable for this purpose, provided the cavity is in normal condition and perfect. If the brain case is intact in the skull, it should be cut in such a way, that one half of the case can be lifted off. A cut is made in a straight line through the middle of the skull from the foramen magnum to the front of the brain case, that is to the olfactory lobes, and then from there cut across at a right angle on one side of the skull only; that is from the middle of the skull on one side, it leaves one half of the brain case in the skull and the other in the piece cut out. This enables us to clear the cavity thoroughly of matrix or dirt and to shellack and oil it in the same way as other bones to be cast. Before the two halves are placed back in position care must be taken to stop up all foramina with clay in such a way as to let the base of the foramina show in the shape of warts (from $\frac{1}{4}$ to 1 inch long) on the cast so as to show their respective location.

For all brain casting the gelatine should contain more glycerine than that for moulding since greater elasticity is required; and in case the gelatine

cast is not reproduced in plaster it is preferable to mix but very little water with the gelatine so that the cast may keep its size and form a long time when kept in not too warm a place — since warm weather will deform the cast. Any desired color may be given to the gelatine cast by mixing the gelatine with dry colors the same as used in coloring plaster.[1]

In duplicating brain casts a plaster cast has to be taken from the gelatine cast first. The plaster mould should be made in two parts from the gelatine cast which allows the gelatine to separate easily from the plaster mould. The latter must be shellacked and oiled like any other plaster mould. After being filled with plaster and allowed to set firmly, the mould can be taken off in pieces, as a so called "waste mould" then the plaster cast may be treated like any other object and a gelatine mould should be made to cast from.

Reproducing Bones in Papier-Maché.— Reproductions in *papier-maché* are frequently made of larger bones and especially of restorations, in order to reduce the weight of the reproductions. The casting in *papier-maché* is a slow operation and has to be done well in order to obtain good results. This method is of minor importance in a palæontological laboratory since plaster casts can be made hollow and strengthened with wire cloth or burlap, which makes them almost as light as those reproduced in *papier-maché*.

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[1] Mr. J. W. Scollick, preparator in the United States National Museum, at Washington, published some years ago in the Proceedings of the National Museum, Vol. XVI, p. 61, a short note treating the subject of making gelatine casts. In describing the reproduction of fowls' combs, he says:

"Preparations with glue (or gelatine) for their basis having been used successfully for anatomical models, casts of fishes, etc., it seemed probable that this substance could be employed with advantage for artificial combs. After considerable experimenting the following combination was found to give good results:

	Ounces
Best Irish Glue	4
Gelatin	2
Glycerin	4
Boiled linseed oil	$\frac{1}{4}$

" The glue and gelatine should be softened in 60 per cent. alcohol, only enough being used to barely cover them. The object of this is to introduce as little water as possible into the compound.

" The glue should then be melted and the glycerine stirred into it, together with a few drops of carbolic acid or oil of cloves.

" Casts made of the above material have lain exposed to the sun for an entire summer and been kept in a warm, dry room for the rest of the year without shrinkage or other change of form.

" Owing to the small proportion of water, this compound is so dense and dries so rapidly that it is poured with difficulty into the mould. . . .

" By slight modifications in the proportions of glue and water and by varying the method of manipulation, casts may be made of a great variety of objects, and the compound is of course, equally available for gelatine moulds.

" It must be borne in mind that the addition of more water, while increasing the fluidity of the melted mass, also increases the amount of shrinkage of the cast, since, sooner or later, the water must dry out; still, in most instances, a small amount of shrinkage is of little consequence."

If bones are reproduced for mounting as a skeleton, plaster casts are preferable, since in mounting iron rods can be passed through the bones and fastened inside with plaster, which cannot be done with a cast of *papier-maché.* However, it may become necessary to reproduce a very large bone, pelvis or skull in *papier-maché* and I therefore will treat the *papier-maché* method very briefly.

In *papier-maché* casting plaster moulds are necessary; since the mass used for casting has to be pressed and pasted solidly to the mould, this would make a gelatine mould useless. These plaster moulds should be treated in the same manner as when casting in plaster, that is, the mould, after being sufficiently dry, must be well shellacked, and then a very thin coat of oil applied — not enough, however, to soak into the paper.

For small and delicate casts I find it practical to use blotting paper or other soft paper, soaked in a thin paste of liquid glue and whiting and applied to the mould in the same manner as wall-paper is handled. The paper should be cut into suitable strips and successive layers be applied until the cast has the required thickness. Care should be taken that the paper becomes well shaped to the mould, which easily may be accomplished with the fingers and brush. This, of course, can only be done if the mould is open, that is in parts. With most casts it is sufficient if the mould consists of two halves; however, it may become necessary, as in the case of a large skull, in order to free the cast from the mould, that the latter be made in several parts.

Wherever paper pulp is obtainable, as in paper mills, etc., I find it most practical to complete the cast with it. After two or three sheets of soft paper are pasted on to the mould, the pulp (out of which the water has been pressed) should be mixed well with the paste I mentioned above (liquid glue and whiting in which the glue may be thinned down to half its original consistency), kneaded to a dough-like consistency and added on to the cast over the paper layers, until it becomes of the thickness and strength required.

To produce a sharp impression of the texture of the bone the outer layer of paper should be of a very soft, thin kind so as to work in close to the surface of the mould, and the paste should not be of too thick a consistency. The casts should be allowed to dry in the mould to avoid warping afterwards, and for larger casts the mould may be constructed in such a way that the parts overlap one another, being flush on the outside. This enables the caster to make a strong connection between the single parts. The latter should be fitted together tightly and fastened with a strong pulp mixture.

For very large casts it is advisable to press the pulp-mixture directly to the surface of the mould, which may be further strengthened with wire netting in the same way as in plaster casting.

If paper pulp is not obtainable, any kind of old, soft paper, soaked in water, and cut and ground in as small particles as possible, will answer the purpose, especially for larger casts. Some *papier-maché* casters use flour paste to mix with the paper or pulp, others use book-binder's paste for pasting the layers of paper together; either of these processes may be practical for a certain kind of casting, but a mixture of strong glue-water and whiting, not too thick, makes a paste which is most reliable. Liquid glue is best since a mixture with ordinary carpenter's glue requires to be kept at a temperature high enough to prevent becoming stiff. By some experimenting one will learn the right kind of mixture to use; too much glue in the paste has a tendency to make the cast crack when dry.

To give the paper cast a greater resistance and to make it damp-proof it should be well soaked with a solution of shellac, when dry; and little defects on the finished cast may be remedied with a thin mixture of shellac and whiting, which also may be colored to suit. A colored cast can be produced if dry colors are mixed with the material used in casting, such as paper, pulp, etc.; this has the advantage of not showing the scratches on the finished cast if roughly handled. The shellac coating on the cast makes a good size for the paint, although boiled linseed-oil or varnish may also be applied to harden the surface of the cast.

In making "waste moulds," that is moulds that are only used once, it is advisable to apply close to the specimen a thin coat of plaster, tinted with sienna or green and when set, to complete the mould with white plaster. This colored layer will help to indicate the nearness of the cast when the mould is being removed.

Mounting Fossil Skeletons.

In my preliminary paper I briefly mentioned the subject of mounting but did not have the opportunity then to say anything about the most important thing in a mount, namely the pose of the skeleton.

A large number of fossil skeletons have been mounted within the past fifteen or twenty years in the museums of America as well as in those abroad, and I dare say there is still left a wide field for improvements from both the technical and the artistic standpoints. Going through our exhibition halls, I often feel a strong temptation to make changes in our former mounts; changes, which, I am sure, would improve the naturalness of those skeletons immensely.

It may be stated, however, that fifteen years ago the making of instantaneous photographs had not been developed to the perfection it has attained to-day. In those days photographs of animals in motion were rarely seen, and even harder to obtain.

It is impossible, it seems to me, for the eye to observe all the movements of an animal closely and to apply these observations by mere memory; but the camera will catch what the eye cannot, that is, it will record the position of every part of the animal's body while in motion.

During the past eight or ten years we have employed in the American Museum photographs of living animals as guides in the mounting of fossil skeletons. For this purpose the photos of such living animals were selected

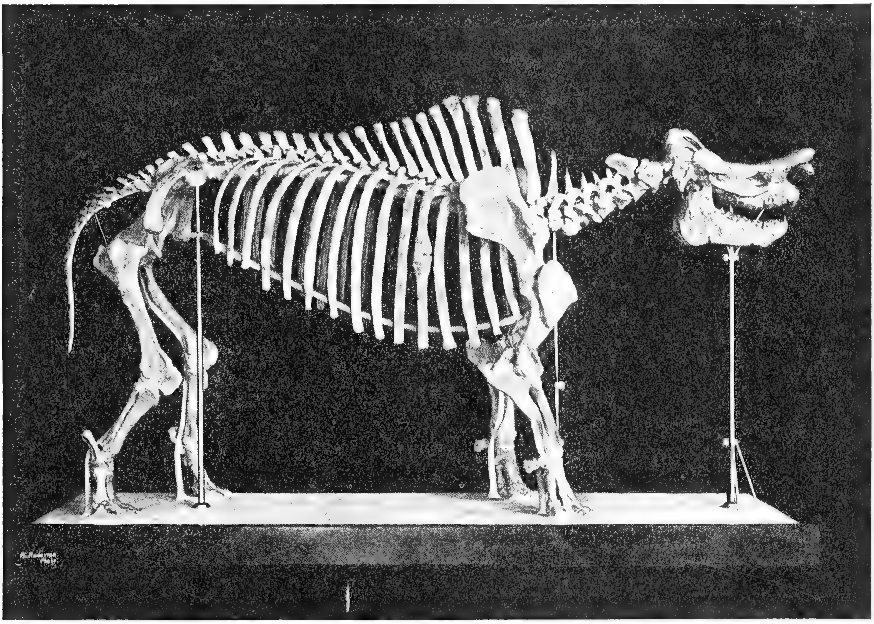


Fig. 8. Skeleton of *Titanotherium*. Old style mounting; supports not concealed as well as in later work.

as resembled the fossil skeleton in hand most closely, as far as form and character were concerned.

In mounting fossil skeletons of horses, camels, deer, rhinoceroses, elephants and so forth, good guides can be obtained from the living forms, and any pose can be studied with absolute accuracy from instantaneous photos of the living animals. There are, however, extinct animals, that have left no survivors of their family: their skeletons require a careful study in order to ascertain the pose of the animal in life, and in our Museum this is generally determined after careful studies by Professor Osborn and members of his staff. In the case of these a student of comparative anatomy finds great help in studying the attachments for the muscles to the

bones, and I may say that in a great many instances the approximate pose of a skeleton can only be determined from the rugosities on the bones, indicating the stronger muscular attachments, from the facettes of the joints, and from the general shape of the vertebræ and other bones.

In the case of reptilian skeletons where the articulations of the joints are generally rather indistinct, the positions of certain bones can only be determined by making careful memoranda recording the position of the bones as found in the matrix. Without such memoranda it is impossible in many

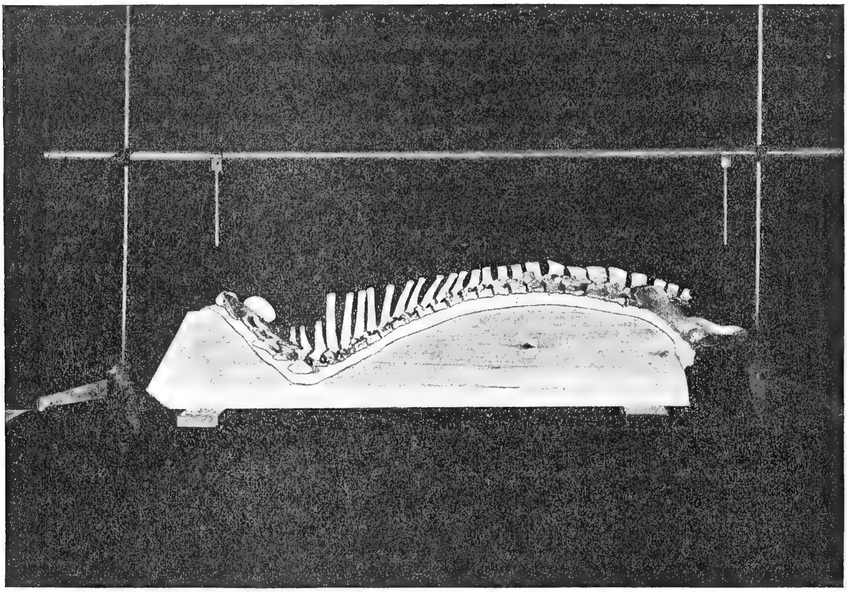


Fig. 9. Temporary wooden support for back-bone, with uprights and horizontal bar.

cases ever to bring such bones to their relative positions, and this will make it difficult to represent the natural form of the skeleton.

Arranging the Skeleton for Mounting.— The skeleton to be mounted should be completely restored if the condition of the specimen makes it necessary. The vertebræ may be mounted on a wooden frame, shaped to the curvature of the backbone in the living animal. (Fig. 9.) The vertebræ then should be pressed in a strip of clay, which is laid over the board, so that slight changes can be made into the positions of the vertebræ. For small skeletons one board used edgewise is sufficient, for larger skeletons two boards may be fastened together leaving a space between them of two to six inches (according to the size of the skeleton) and put up edgewise in such a

way as to form a saddle for the vertebræ. This makes a good temporary support, and by the aid of wooden blocks and clay the vertebræ can be placed very accurately. Before shaping the rod which is to support the backbone, the vertebral centra should be freed from all obstructions on one side, so that their position be accurately determined and so that the support can be bent and shaped to fit the bones. Figure 10 represents a skeleton temporarily set up for studying the pose.

Here I may mention that where the support or rod is to run through the neural canal, it should be shaped over the transverse processes or rib facettes on the vertebræ, so as to give the exact shape required. If a rod is employed to hold up the vertebræ from the bottom, as may be the case in

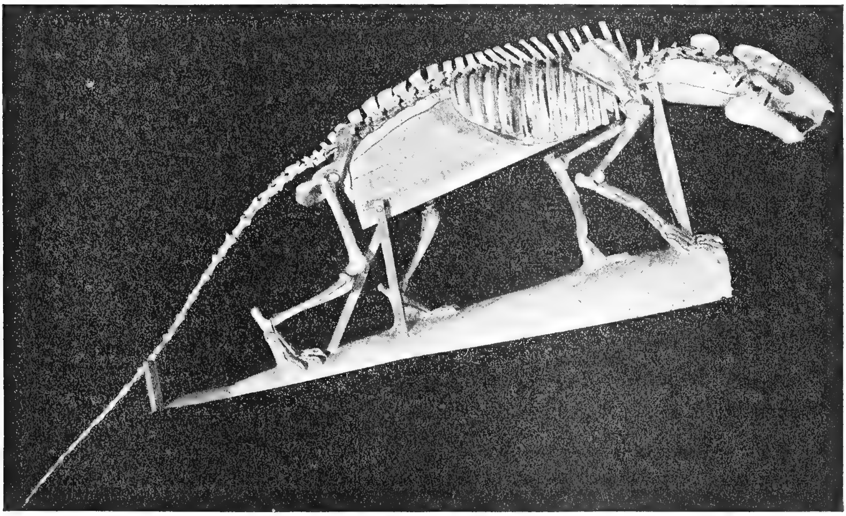


Fig. 10. Skeleton temporarily set up, for studying the pose.

mounting very large skeletons, or of skeletons in which it is desirable that the bones be detachable from their respective supports, the rod should be shaped to fit the bottom of the centra as closely as possible.

My intention is now to go somewhat into the details of the mode of mounting skeletons so that every bone can be detached for study, to be cast, or for any other purpose.

We have mounted a number of skeletons in the American Museum in which the vertebræ fit in a plaster-, or in two or three cases, in a metal-bed; in other words the plaster or metal is cast on the bottom of the centra allowing enough support to hold the vertebræ firmly in their places. This is executed in the following manner:

After the vertebral column has been placed in proper position on clay, a thin sheet of plastiline may be pressed on the top of the vertebræ, covering the spines and neural arches enough to hold the column in position. A layer of plaster may be put over the smooth surface of the clay to strengthen the support and this can further be reinforced by an iron rod, set into the plaster. This makes the vertebral column a solid body, which can be lifted from the clay underneath. Now, when turned over, bottom side up, a channel may be built with clay on the sides of the centra, in which the plaster or metal, whatever may be used, is poured, which will leave, when set, the impression of every vertebræ. Before the plaster or metal sets, the supports for the backbone (a soft steel or iron rod) of the required thickness and shape, must be pressed into and become covered with the soft matter, which was poured over the vertebræ. When set and taken off the column, it may be cut and shaped in such a way as to leave one side of the centra free to the middle line, so that the side view is not obstructed on one side (Plate LII A). However, enough imbedding must be allowed to hold the vertebræ firmly in position. It may be necessary to mention, that before pouring the plaster, etc., on the centra, care must be taken that the spaces for the cartilage between the vertebræ are stopped up with clay to prevent the mixture running into them.

For small skeletons I can recommend casting the backbone support of fusible metal, a composition of three parts bismuth, two parts tin and one part lead, or of bismuth three, tin one and lead one. This composition melts at a comparatively low temperature (in boiling water), and has but very little shrinkage. The channel for this casting should be built of potters'-clay, since plastiline will melt somewhat, from the hot metal. The bones should be painted with glycerine instead of oil and the backbone support put in place before the metal is poured. This metal, however, is not adaptable for large skeletons, since, when cast in large lengths, it would have enough shrinkage to lose accuracy.

In a skeleton of a large dinosaur, *Diplodocus,* which is mounted in the Carnegie Museum at Pittsburgh, the backbone is supported in the above manner; but the castings were made in sections of about six feet each to make up for the shrinkage. The casts were first made in plaster and then cast in steel and the sections spliced together, an operation which can be easily accomplished with iron or steel, but not with soft metal.

There are numerous other methods for mounting the backbone of a skeleton, so that the single vertebræ are detachable. Those employed in our museum I will here briefly discuss. The rods to support the backbone, that is those which run under the vertebral column, may be of different shape and form to suit individual tastes; round, half-round and square have

been employed in the American Museum, and I will say, the half-round style, wherever strong enough, is to be preferred, since it can be shaped to the bones closer than the other styles (Fig. 11, E).

When the vertebræ can be bored with a good steel drill, it is practical to rest them on vertical pins of the required size, which may be fastened to the backbone rod either by fittings, which slide over the rod, allowing the vertebræ to be moved to and fro, or to be screwed tight to the rod, which makes them stationary.

The latter method is not practical with many skeletons, especially those in which the zygapophyses are tightly interlocked, since it becomes almost impossible to remove one vertebræ without moving the adjacent one, a fact already referred to in my preliminary paper.

As shown in the illustrations (Fig. 11) the fitting or sleeve, which slides over the bar, can be cast of bronze or iron very

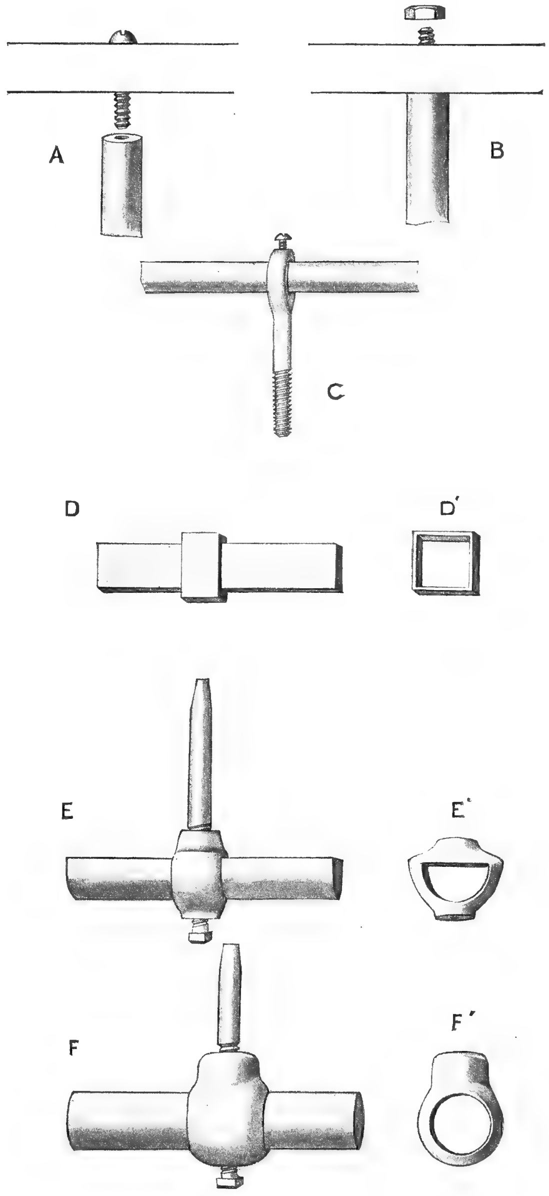


Fig. 11. Uprights fastened to back-bone rods (A. B, C.). Back-bone rods with sleeves and pins (D, E, F, D′, E′, F′).

lightly. A pin can be screwed in to hold the vertebræ and it can either run into the holes in the centra, if they can be bored, or if too hard to bore, the rod or pin, which is screwed in the fitting, may be split so as to serve as a clamp. If square rods (Fig. 11, D) are used for backbone supports a square bronze tube, drawn (Fig. 11, D) over the rod to fit, may be cut in pieces to serve for the sleeves, from ½ to one inch in length, according to the size of the skeleton to be mounted; and the supports for the vertebræ may be soldered or screwed on. The fittings to slide over a round rod must be provided with set screws to avoid turning (Fig. 11, E, F); also in those skeletons, especially the larger ones where the backbone has a more or less vertical position, set screws should be used to hold the sleeves in place.

Recently we have been experimenting with an entirely new style of backbone support, which I think will be superior to many others (Fig. 12). This is a channel rail of sufficient strength, lipped on both sides of the open

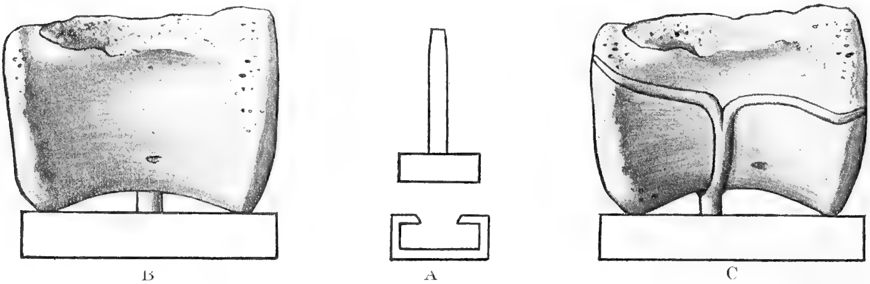


Fig. 12. A, Channel rail support with block and pin; B, vertebra bored, with pin inserted; C, vertebra supported by pin split twice.

top in such a way that a block which fits snugly in the channel, is allowed to slide freely, and is held in place by the lips above (Fig. 12, A). This makes a neat support, since it does not show any rings, etc., on the outside of the rod and otherwise works exactly the same as the sleeve fittings, that is the pins etc. may be fastened in the same manner. Ordinary square bolt-nuts of the required size to fit the channel will answer for this purpose, and the pins, screwed in tight to press against the bottom of the channel, will serve as set screws to hold the bolts in place.

For smaller skeletons the above mentioned channel bar of hard bronze is advisable. This may be obtained at factories where brass tubing is manufactured; for large skeletons, however, steel or iron bars are preferable.

All the above mentioned backbone supports should be reduced in diameter in the region posterior to the sacrum; and the tail support should be tapered gradually.

The skull can be supported from the backbone rod by adding attach-

ments for holding it in position. In larger skeletons it may be necessary to use an additional brace coming from the vertical rod, or even an extra upright as in the case of very large skeletons.

The neatest support for the backbone is a rod running through the neural canal, that is, if the latter, when cleaned is large enough to allow a sufficiently thick rod to pass through. This method is practical with all mammal skeletons and also with reptiles of not too gigantic a size; it will, however, prevent the dismantling of the vertebral column.

The space between the vertebræ may be filled with plaster or *papier-maché*, colored like the matrix in which the skeleton was imbedded. This makes the backbone rigid and strong, and the plaster etc. between the vertebræ may be bored for fastening the ribs. In order to hold the vertebræ in their proper places I generally fasten a copper wire around the rod running through the canal, twisting it once or twice, with a loop between the vertebræ imbedded in the plaster. This holds each vertebra close against the rod.

Uprights.— The mounted vertebral column has to be carried by uprights or vertical rods, except in the case of very small skeletons in which the backbone may be supported by the fastenings that hold up the limbs (Plate LIII). With mammal skeletons two uprights are, in nearly all cases, sufficient for support. The one in front should have connection with the vertebral rod between cervicals six and seven to allow space for the sternum; and the rear one should be between the last lumbar and first sacral vertebra.

In the case of very large mammals, such as the mammoth or mastodon, it becomes necessary to employ an extra upright to support the skull. The fastening of the upright to the backbone rod can be done in various ways: (1) By boring the horizontal rod, allowing the upright (the diameter of which should be reduced here) to pass through the hole until reaching the shoulder on the upright, made by the reduction of the circumference of the latter, the upright then being tightened by a nut on the top of the horizontal rod (Fig. 11, B). (2) By boring the backbone rod and boring and threading the upright, then screwing both together by a machine screw (Fig. 11, A). If boring the horizontal rod might weaken it, a button-hook shaped pin may be used, which hooks over the backbone rod and is fastened by a set screw so as to stay in place, the lower end being threaded and screwed in the hole in the upright (Fig. 11, C). The latter style is only adapted to skeletons where the rod runs through the neural canal.

In mounting larger reptile skeletons the number of uprights must vary with the size and bulk of the skeleton. This matter I shall return to later.

Mounting the Ribs.— After the vertebral column is mounted in natural position and the uprights fastened to a temporary base, the next thing will

be the placing and fastening of the ribs. As to their natural position that must be left to the preparator, like the questions of the form of the backbone, the pose of the limbs and feet; these matters depend entirely upon the knowledge and the amount of special study of nature by the preparator.

To support the ribs I find it practical in nearly all mammal skeletons to fasten the rib supports in front to the upright; in the rear to the backbone rods, either between the first and second or between the second and third lumbar vertebræ, although this is not the rule with all skeletons. If the front upright is reduced in size at about the height of the chest, the shoulder formed acts as a support for the rib-rod which, when shaped close to the upright and screwed or riveted to the latter is very strong. A neater appearance, however can be obtained if the upright (which is of one size in its whole length), is filed out all around its circumference to the thickness of the rib-support and the latter fitted into this slot neatly and screwed fast (Plate LII, B). The latter method applies principally to smaller skeletons.

The rear ends of the rib-supports I generally fasten in this way: an extra flat piece of soft steel of the proper size is shaped over the backbone rod and screwed to the latter allowing on each side enough projection for two screws, with which the rib-supports are fastened firm to the cross piece.

For small skeletons the rib rods may be of flat steel; for larger ones half round or channel rods are preferable — the latter with the channel inside leaves a suitable space for the nuts with which the ribs are fastened to the rod.

Fastening the Ribs.— All ribs that are too hard to bore should be held together and reinforced by a wire running along the inside and imbedded in plaster, which may resemble the color of the matrix in which the skeleton was found. The plaster can be cut and shaped so as to cover only a narrow strip of the bone. In mounting very small ribs the wire support may be left a little longer on the top end so the projecting part may be bent to serve as a hook which may be fastened between the centra of the vertebræ. In mounting larger ribs it is practical to have the wire support the exact length of the rib and a somewhat lighter piece of wire should be imbedded with plaster on the head of the rib, which serves as a fastener for the top.

If the space between the vertebræ, representing the cartilage, is filled with plaster or *papier-maché* it becomes easy to get a hold for fastening the ribs by boring holes in the plaster etc. If on the other hand the column is arranged so as to be taken apart when necessary, the ribs must be fastened in such a way that they can be separated from the vertebræ at will.

The lower ends of the ribs may be fastened to the supports either by screws, running through the ribs and the supports with nuts on the inside, or with a fine band fitted around the ribs and passing through two holes in the support, and clinched on the inside. A neat fastening can be obtained on

small skeletons by twisting two small flower wires together which, when bent around the ribs and twisted on the inside of the rod is almost invisible.

Limb Supports.— Hard limb and foot bones which cannot be bored naturally have to be held up by rods of either flat or half round steel for al' moderate sized skeletons. Flat steel is preferable for the smaller skeletons since the narrow band-steel can be fitted snugly to the bone, and it is' moreover, least conspicuous. Half round rods are more practical for the, support of limbs of a more massive construction.

For very large and heavy limb bones such as those in dinosaur skeletons (as for instance in our *Brontosaurus* skeleton where the left femur weighs 850 pounds), a round Bessemer steel rod is the safest, since the half round steel is likely to bend at the joints unless it is of large diameter, which, however, would make the supports look out of proportion. In order to fit the supporting rods on the bones neatly, the limbs may be held up by temporary supports of strips of wood or iron to which the bones may be fastened in such a way that these supports do not interfere with the fitting of the permanent rod.

If the foot bones are mounted on a plaster pedestal (p. 328), the limb support may follow the latter closely to the base, where it should be fastened securely. If the foot bones are bored and mounted like recent feet, or if the isolated digits are supported by bands of steel, the limb supports may be carried under the feet as close as practical so as to make them the least conspicuous.

To reinforce the two sides of limb supports on the top the rod of the fore limbs may be fastened to the rib support first, then the two sides may be connected. This applies to smaller skeletons; with large ones it often becomes necessary to run up the rod, following the scapula and extending across to the backbone support where it may be fastened by screws.

The hind limb supports may run under the acetabulum and meet on the other side of the pelvis, where the two rods should be spliced together. In large skeletons it often becomes necessary to run up the limb supports on the inner side of the pelvis to the sacrum, where they may be fastened to the backbone support either with a screw running between the vertebræ, as may be the case when the rod passes through the neural canal, or directly to the rod, if running under the vertebral column.

The individual limb bones should be fastened to the supports by means of narrow and very soft band-steel or copper wire, which should be fitted around the bones neatly and fastened to the supporting rod by very small machine screws. The size of these bands of course depends upon the size of the rods employed. The more neatly they fit the bone the less noticeable they will be in the finished mount (Fig. 13). Fastening the bones to the rods by means of bands is advisable only for bones too hard to bore. Nearly all Plio-

cene and Pleistocene bones can be easily bored and in such cases it looks neat if the bones are fastened to their supports by screws. This can be done in this way: Brass tubing (which can be obtained in all sizes) should be inserted into the bones after a thread has been cut in the tube. The bone should be bored as deeply as possible so that the tube fits the bore pretty tightly. If the bone is porous and soft, the bore should be soaked with strong shellac before the tube is inserted to strengthen it and after being allowed to dry, the tube may be coated with a mixture of shellac and whiting which holds the tubes firm. The support should not be screwed on to the bone until the tube becomes perfectly set in the bore. The last mentioned method makes the handsomest looking mountings for skeletons in which it may be necessary to have the bones detachable, as one can observe in the American Museum from several skeletons mounted in this manner; on the other hand, when the bones may be stationary as with a recent skeleton, it is more practical to bore the bones and fasten them together by wires (Plate LII, B). All wires can be made invisible by selecting the proper place for their insertion; however, this must be left to the judgment of the preparator. The feet can be made very rigid, if after the bones are bored and the wires inserted, the joints and spaces between the separate bones are filled with plaster of the matrix color. Two wires should be allowed to run out of the carpus and into the radius and ulna two wires are also required to fasten the tarsus to the tibia and fibula (see page 329 for mounting of feet).

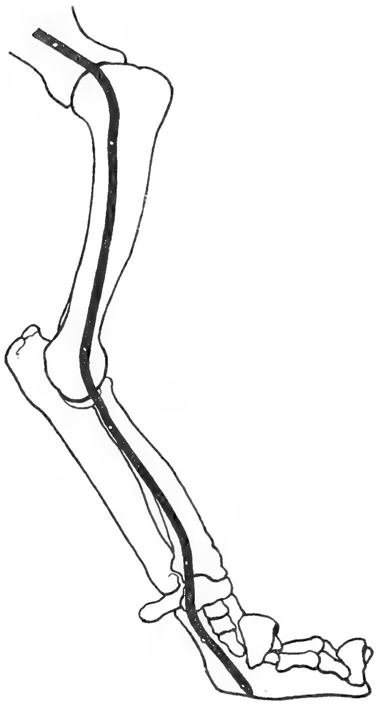


Fig. 13. Flat steel band fitting along inner side of limb, fastened to tubes inside the bones by means of screws.

For the elbow joint and for the scapula, in most instances, one wire is sufficient, whereas for the knee joint two should always be employed, to prevent turning. The wires should enter the limb bones sufficiently deep enough to hold them firmly together. For fastening the wires in the bones I prefer either shellac and whiting, or a mixture of liquid glue and plaster, in some instances gum and plaster may be strong enough. Sufficient time

must be allowed for the wires to become fastened in the bones before they are handled, otherwise the joints may become loose.

Supporting the Skull.—The skull in nearly all cases requires extra mounting which holds it and the lower jaws firmly, allowing them to be lifted off their mountings. For small and light skulls which can be supported from the backbone rod, I generally use a flat rod which may be spliced and screwed to the backbone support providing the latter is square; if, on the other hand, the backbone support is round in diameter the skull support should be round at one end so that it can be threaded and fastened to the backbone rod by means of a plumber's coupling. Either one of these two styles of rods can be flattened out and lightened and the end may be split so as to serve as a fork in which the skull rests firmly. If required, other small flat cross bands may be screwed to the principal rod and fitted to the skull to hold the latter securely. The lower jaws can also be suspended from the rod above. If the skull can be bored, it is advisable to fasten two pins into the support to enter the skull, one in the region of the palate about on a line with the first premolar tooth, the other at the most suitable place in the back part of the skull. These pins should be arranged so that the skull can be lifted off easily. The lower jaws can be suspended in front and back by two light bands or wires coming from the main skull support. To support heavy skulls the mountings should be made relatively stronger, and where an extra brace from the upright is required, it should be so arranged that the latter carries all the weight. The cradle in which the skull rests may be constructed of a flat iron rod on which cross bands are fastened to hold the skull in position; the lower jaws may be suspended from this main support as indicated above. This cradle can be fastened to the brace or upright underneath by splitting the upper end of the vertical support which may be opened and screwed on to the cradle.

We introduced some years ago a very simple method for supporting skulls either on the skeletons or in single mounts. Two pieces of annealed brass rod are cut off the required length and split lengthwise at the ends so that the two halves when opened out at right angles to the unsplit part reach around from the median line of the palate in such a manner that they may be shaped close to the skull so as to hold it firmly. One of these should be in the front and one in the back part of the skull (Fig. 14). The two rods are threaded at the ends and screwed to a plumber's T, which can be screwed to the vertical support. If the two rods are slightly arched (not too much so as not to show under the lower jaws), they are stronger. For large skulls soft steel rods may be employed in place of brass.

The lower jaws may be suspended from the round rods either by a soft wire which runs through a hole in the rod and is twisted below, or by a small, flat band of steel which is either screwed or riveted to the rod above (Fig. 14).

In the mounting of small skulls the brass rods may be split twice so that the plumber's T becomes unnecessary. A soft brass rod of the required size is split far enough, so that the two halves may be opened and arched as in the foregoing method; the ends may then be split again and opened forkwise to serve as clamps for holding the specimens firm. If the brass is bent forward and backward too often it becomes hard and is likely to break off; this can easily be prevented by repeating the process of annealing. Brass becomes soft in being heated to a cherry red color and then being dipped into water.

The above method of mounting skulls applies to the skull on the skeleton

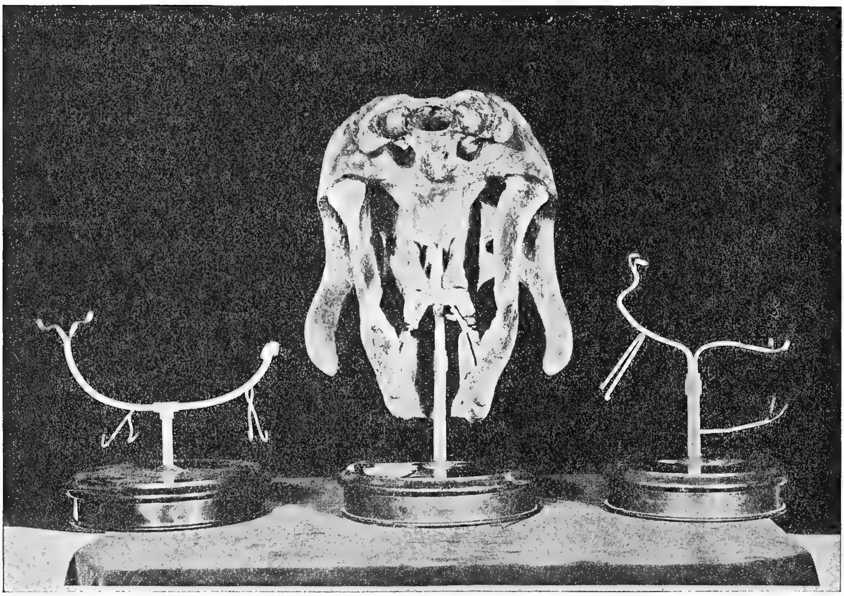


Fig. 14. Pedestals and mountings for skulls and lower jaws.

as well as to separate skulls; and as to the latter, that is skulls without skeletons, I may add a few words regarding the style of pedestals employed.

Many years ago we introduced in the American Museum a round pedestal for single mounts, such as skulls, limbs and feet and so forth. The base is made of two parts, a pedestal about two inches, with a platform one inch thick (Fig. 14). The platform rotates on little rollers inserted in the pedestal and is held in place by a pin or by the upright or stem which supports the specimen passing through the center. The specimen can be shown at any angle in the case by rotating the platform of the pedestal.

The stem runs through both platform and pedestal, bearing a rosette at the top and a lock-nut on the under side of the platform (Fig. 14). This makes the stem stationary in regard to the platform, and loose with regard to the base. By using another lock-nut at the bottom of the base, both parts will hold together.

However, the rotary motion can be brought about in the stem alone (Fig. 15, A), leaving the base or pedestal solid, a method which I observed lately in the Carnegie Museum at Pittsburgh. In this method, the vertical rod which supports the specimen consists of two parts which meet at about the middle. The lower stem being fastened solid to the base with a rosette at the top and a nut at the bottom. A sleeve of either brass or iron tubing is slipped over both halves of the stem fitting solidly over the lower part resting upon the rosette and somewhat more loosely over the upper stem so as to allow rotation. The sleeve should come up so as to almost touch the cross-mounting in which the specimen rests. The end of the two stems should be rounded off to allow free turning on each other in the sleeve in which they are held firmly; but the specimens may be easily lifted off.

Another method, similar to the above and somewhat more simple, is the following one (Fig. 15, B). A plumber's T can be employed with the vertical or outlet somewhat longer than the horizontal part. This probably would have to be made specially for some mountings. The lower part of this T serves as a sleeve as mentioned in the foregoing method, and requires only one solid stem or upright instead of two as described above. The T is screwed on to the mounting which supports the specimen in the ordinary way, and instead of being threaded on the vertical end as the ordinary T would be it is reamed out smooth and slipped over the stem, which is fastened to the pedestal in the regular way. This method has some advantage over the one just described, since it makes it possible to bring the specimens within an inch or two of the pedestal, that is the T may touch the rosette on the base, a circumstance, which cannot be accomplished with the method first mentioned.

A third method (Fig. 15, C) to bring about the rotating of the mountings in the stem or vertical support is to use for the upright a gas-pipe, which is fastened to the base and in which the upper part of the mounting rotates. This, however, is only adoptable in case a plumber's T is employed to which the upper mounting is fastened.

In mounting single limbs, the specimens should be treated in the same manner as they would be if mounted on a skeleton. The larger limbs, such as those of mastodon, mammoth or larger dinosaurs, require extra braces coming from the pedestals and fastened to the half round or flat iron, which runs along the bone. The single bones should be held in place with hooks,

fastened to the bone supporting rod. The fittings which slide over the half round rods are very useful in this case, since they will serve to fasten the bone-supporting hooks as well as to fasten the vertical rod or brace (Fig. 16).

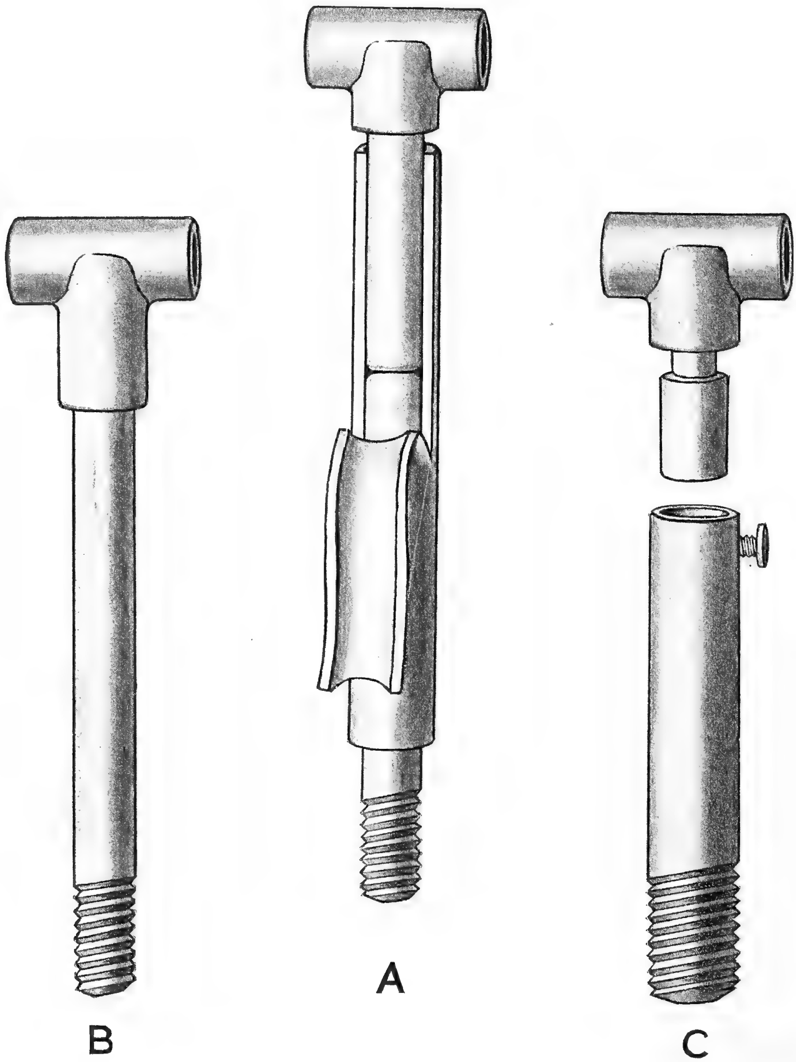


Fig. 15. Uprights for skulls and other single mounts.

At the close of the discussion of the mounting of skeletons, that is free mounts of various kinds, small and large, I may say a few words regarding the mounting of large dinosaur skeletons. I previously stated that in the

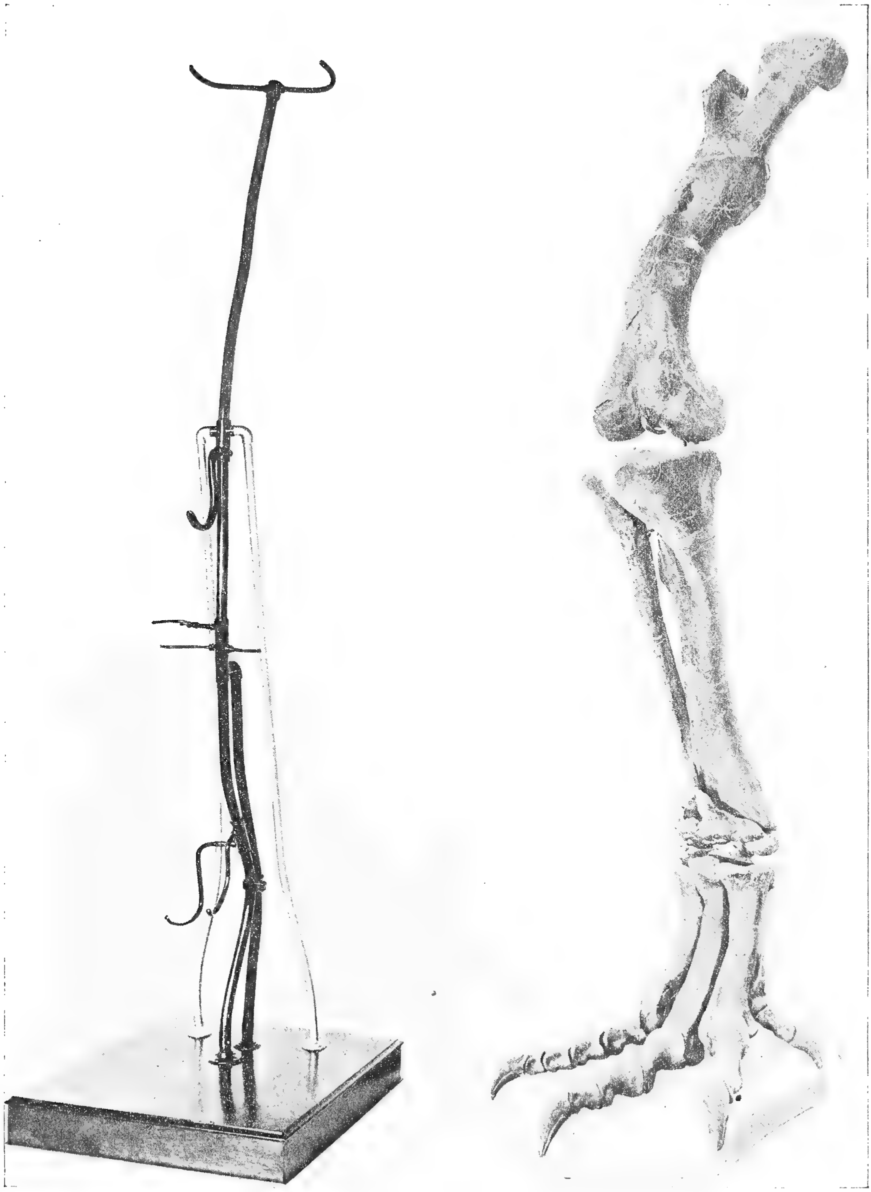


Fig. 16. Mountings and limb of *Allosaurus.*

Carnegie Museum at Pittsburgh there is a mounted skeleton of a large dinosaur (*Diplodocus*) in which the backbone support is of cast-steel, cast from plaster models, which were taken from the vertebræ in position, and in which the inferior surface of the centrum of each vertebra fits in firmly. I consider this a neat style of mounting, adoptable for very large dinosaurs. A slight disadvantage, however, is the fact that the lower surfaces of the centra of the vertebræ are more or less covered by metal and their view is somewhat obstructed.

We have recently mounted in the American Museum two *Trachodon* or

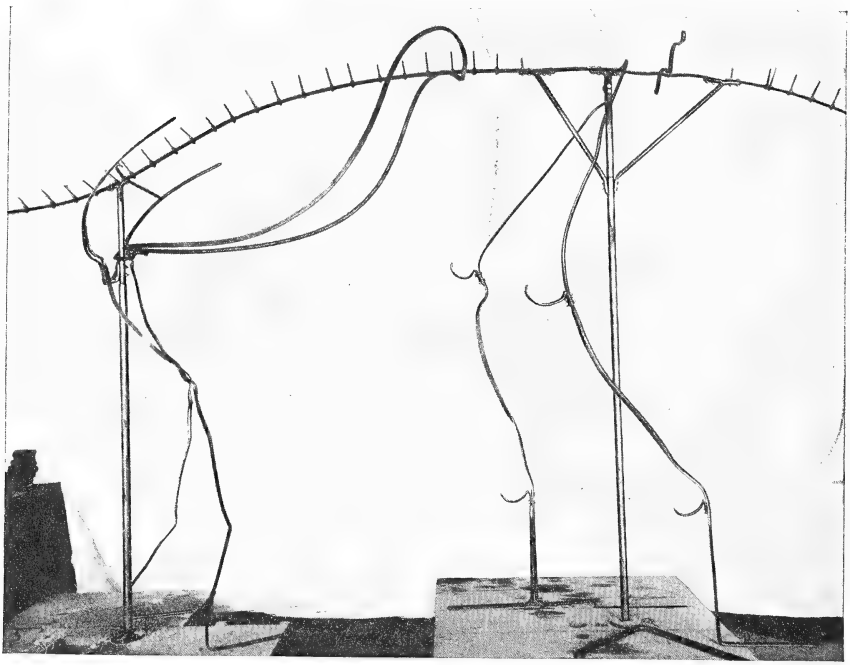


Fig. 17. Support of *Trachodon* skeleton.

duck-bill dinosaur skeletons in which we used the half-round steel for the backbone support, and which makes the least noticeable support of any we have had so far. As the illustration shows (Fig. 17) the fittings for the single vertebræ slide over the rod and each bone is held up by a pin which enters the hole in the vertebra. If the bones cannot be bored they may be held up by clamps fastened to the fittings as previously described (Fig. 12, C). This system to my mind is adoptable for larger dinosaurs by simply increasing the size of the rod and the fittings proportionally. The half

round iron or soft steel can be fastened close to the shape of the vertebral column; but it should not be carried too close so as to obstruct a view of the centra. There are exceptions, however, where a round or a square rod may be more advisable.

For limb supports half round steel is preferable to round (with probably very few exceptions as may be the case with very heavy dinosaur limbs) since we found by testing that the half round steel carries a greater weight than had been expected. Mr. E. S. Riggs of the Field Columbian Museum at Chicago has supported the heavy limbs of *Brontosaurus* with half round steel, which holds them up firmly.

The supports for the individual vertebræ may come from the fittings which slide over the horizontal rod in the same manner as in mammal skeletons, only everything must be stronger in proportion. The fittings may be shaped at the top in such a way as either to allow the vertebral support to be screwed on similarly to a plumber's fitting, if round steel is used, or on the other hand, flat steel may be screwed down with machine screws. How to arrange the supports which run up on each side of the vertebræ cannot be described; this depends largely on the condition of the vertebræ and must be left to the decision of the mechanic. The same holds true for the supports for the pelvis and the shoulder girdle. The limbs may be supported in the same manner as single limbs as already mentioned.

These large dinosaur skeletons do not allow a uniform treatment either in the way of preparation, or of mounting, and no rules can be established to apply to all cases. Wherever such problems arise it requires some study as to the proper and most natural position as well as to the engineering part of the mounting, and it depends principally upon the individual taste of the respective authorities as to what style of mounting is preferred.

Slab Mounts.— Slab or tablet mountings are generally made for skeletons in which the bones are rather poorly preserved, crushed or where the ribs and limbs on one side are imperfect; exceptions however have been made, that is slab mounts have been made of skeletons which were perfect enough for free mounts. These slab mounts may be made in various styles and shapes. As represented in the American Museum collections are some which on top follow the curvature of the backbone more or less closely (Plate LIV, A); others are squared off, the rectangular background being large enough to take in the skeleton (Plate LIV, B). The mode of construction of the slab depends a great deal on the condition of the skeleton.

If a skeleton is found in more or less natural position and the bones can be left in the matrix it is almost always advisable to set them on the slab in the same way, with the least straightening of the skeleton. Our skeleton of *Aceratherium tridactylum*, mounted in this style, illustrates this method very well and is favorably regarded by many scientists.

The mounting of a skeleton in the above style is carried out as follows: The frame may be constructed of wood or iron, whichever is most practical. For very large skeletons, such as large fossil fishes or marine lizards (Mosasaurs, etc.) a strong, wooden frame which can be reinforced with irons at the corners, seems the most practical. The different sections are laid in the shallow, tray-like frame, where the surface of all wood must be either tarred or made waterproof by some other means to prevent dampness from penetrating into the wood. After the sections are anchored to the bottom of the frame by nails or wires, the missing parts of matrix around the sections or under them and all vacant spaces in the frame should be filled with plaster of the color of the matrix in which the specimen had been found. Loose bones, such as limbs, foot bones, ribs and so forth, may be held in place temporarily by means of clay or wire, until the plaster is built up from underneath and they become embedded in plaster which holds them firmly. To hold larger bones in place it may become necessary to fasten extra bands of wire etc. around the bones and into the plaster. Wherever possible the skull should be supported so that it is detachable.

There are many skeletons which are very rare and of unique character, in which sooner or later it may become desirable to take the bones off their mountings either for study or casting purposes. In these cases the bones will have to be cleaned and freed from matrix before mounting. It is also practical in most instances to do all required restoring on the bones before they are mounted.

The vertebral column is then set in clay or plastiline in the required position and each vertebra being pressed in with the inner side far enough to stay in place if the slab is in an erect position. This should be done in the same manner with the inner limb and foot bones. The bones, which were painted with glycerine before having been pressed into the clay, may now be lifted out carefully, so as to leave an accurate impression, and then a plaster, or gelatine mould made over the clay. If a plaster mould is made, a thin layer of tinted plaster should be applied to the clay first and then finished with clear plaster in the same way as any waste mould is made, as described in a former paragraph (page 306). The plaster mould should be made as light as possible and when sufficiently set and turned over, the clay may be removed, and after being treated like any other mould, the cast can be made of matrix-colored plaster and reinforced with burlap, wire gauze or metal rods, whichever the size of the slab may require. When sufficiently set, the plaster mould may be taken off in pieces like any waste mould; and the bones placed in their respective cavities. The limbs of the outer side should be mounted in the same manner as in a free mounted skeleton.

A gelatine mould requires somewhat more time, but is more reliable than

a plaster waste mould. When the plaster mould is cut off from the cast, danger arises, that the latter may become injured by the chisel. This is avoided in using a gelatine mould, since it lifts off so easily. The mould has to be prepared in the manner previously described under moulding (page 300), that is a shell has to be made to hold the gelatine mould in place.

In several cases of slab mounts in the American Museum we have constructed a frame of iron pipes, which were screwed together in the corners with plumber's elbows, reinforced with cross pieces, and the inner space filled out with wire netting. Such frames are practical for mounting skeletons where no wooden moulding or frame around the border is required, since they appear like massive stone slabs.

This method may also be recommended for mounting skeletons in which the bones are partly in the original matrix. After the frame is completed, that is the wire gauze has been fastened to the rods, the sections of the skeleton may be laid in the frame, in the same way as with a wooden fence, and the plaster built under the specimens and all spaces filled so that the entire iron construction is covered with plaster. This style of frame may also be applied to mounting skeletons where the bones have to be detachable. In such cases the bedding for the backbone, and for the limbs and feet will have to be cast in parts and placed in the frame in position, where they may then be set in plaster so as to become fastened to the metal work.

Slab mounts made on iron frames can be made neater and lighter than those made in wooden trays with moulding around the edges (Plate LIV, A). The indoor temperature neither causes the iron to expand nor to shrink, and since the iron rusts in the plaster, plaster and iron become strongly combined; this makes the slabs very durable. I am convinced that large dinosaur skeletons, which have to be mounted in slab style, can be mounted with iron frames, arranged in suitable sections which can be fastened together so as to act as one solid body when in permanent place. The slab can be of a light construction, from one to two inches of plaster over the iron is sufficient to make the frame very rigid, and the heavy limb bones, such as those of dinosaurs can be fastened to the iron parts very easily and the slab as a whole can be fastened without the least difficulty. We may have the opportunity in the near future to make a mount of this kind in our museum.

Mounting Feet on Plaster Pedestals.— The mounting of foot bones in their natural position on plaster pedestals is very frequently done in natural history museums. The method is simple, quick, and since most animals have the largest part of the foot on the ground (*e. g.*, cats, dogs, bears, etc.) it seems more natural to see the bones on a solid block of plaster, than on any other support (Fig. 18). The feet may be mounted so that each bone can be taken off the pedestal separately. This is done in the following manner:—

The bones, after being cleaned from their matrix and, if necessary, restored, are mounted temporarily in natural position on a block of plastiline. In order to hold the bones in position when the foot is to be turned over for casting the pedestal, a very thin sheet of plastiline is pressed on the outside of the bones and a layer of plaster is spread over it, just heavy enough, when

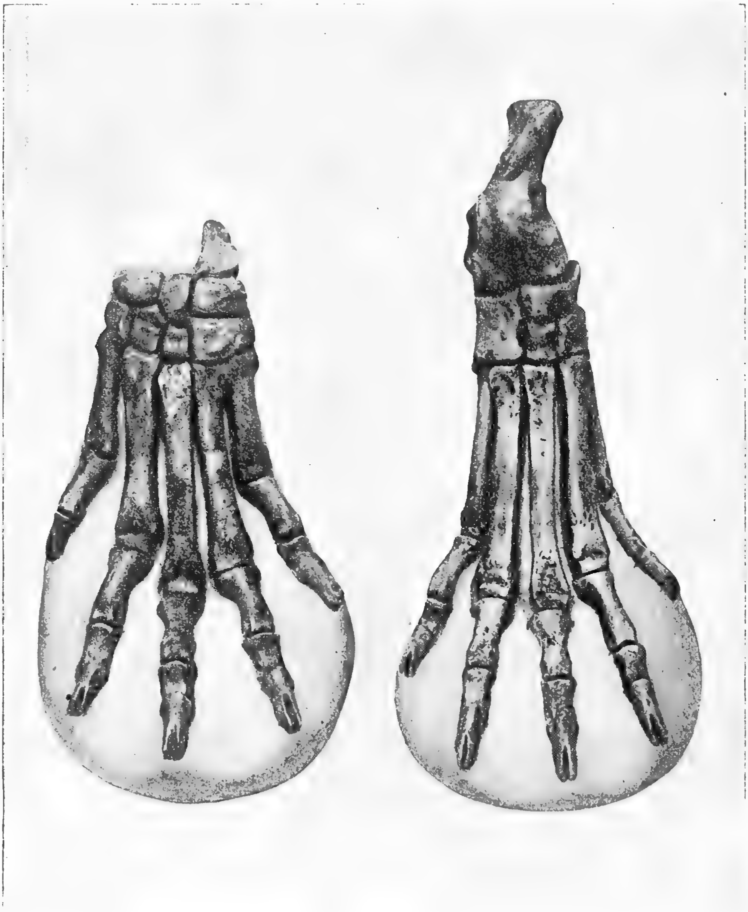


Fig. 18. Fore and hind feet of *Hyænodon* on plaster pedestal.

set, to hold the bones together. Then the plasteline block with the bones embedded may be turned over and the clay carefully taken off the bones in such a way that they are not disturbed or shifted out of their places. The bones may then be treated in the same manner as in casting, and a frame of

clay should be built up to indicate the size and shape of the pedestal. The plaster, which is usually the color of the matrix, in which the bones have been found, should then be poured over the bones and when set, turned over with the bones. The top shell may now be removed and the bones cleaned from plastiline, etc., which is done easily with benzine or petroleum. Before the bones are placed in their impressions or sockets in the pedestal, the latter should be cut and shaped to suit, especially around the edges of the bone-impressions where a sharp cut helps to raise the bones from the pedestal and sets them off distinctly.

The above method of mounting feet may be employed also in the case of mounting skeletons, where the foot bones rest on plaster supports. If the feet are mounted with wires running through the bones, or with iron band supports as may be the case with very large feet, the latter should be mounted on a temporary clay-and-wood support, in natural position first and treated in the manner I have described, since an accurate position can only be obtained if the bones are held in their correct position while being turned over.

The Base for the Skeleton.— In the American Museum we have adopted almost exclusively in mounting fossil skeletons a matrix base, that is, a base which is covered with artificial matrix, or in other words, covered with colored plaster of the shade of the original matrix in which the skeleton had been found. This method is favored by most palæontologists since it is an improvement over the appearance of the fossil bones when mounted on a wooden base. The base is generally constructed of ordinary pine boards, framed with a better quality of wood, such as mahogany, etc. The frame should be deep enough to allow space for a nut beneath the bottom to fasten the uprights and for a shallow tray on the top of the platform from one half to one inch deep for holding the sheet of artificial matrix. This tray must be well tarred to prevent the moisture from penetrating into the wood and so save it from becoming warped or cracked. For larger bases it becomes necessary to employ heavier wood and to reinforce the bottom with cross cleats.

To prevent the cracking of the plaster, a sheet of wire gauze should be tacked to the bottom of the tray, loosely enough to allow the netting to become embedded firmly in the plaster. After the latter is shaved and smoothed it may be scratched and chipped either wet or dry to produce the appearance of a stone slab cut by a stone cutter (Plate LIV, B). Although exposed to the dust of the exhibition room these bases are easily kept clean, since they may be washed off easily. However, the style of bases is largely a matter of individual taste.

Machinery and other Appliances.

At the end of this paper I desire to say a few words more in regard to the tools and appliances employed in our laboratory. In previous pages (p. 288–295) I have mentioned the different tools which we have found in our experience most adaptable for certain kinds of work and a brief description of other appliances and machinery in use in our laboratory may be of interest to some readers.

I mentioned in my previous short paper [1] the installation of an overhead trolley system in one of our large laboratory rooms. This consists, as shown in Plate LV, of a steel rail, similar in shape to a railway rail, which is fastened to the ceiling. On this are trollies, to which hoisting blocks are attached, rolling to and fro freely.

The trollies can be obtained of different sizes, according to the weight they may have to carry. Ours are from one half to two tons lifting power. This system is of immense assistance in mounting large skeletons, especially of those of some dinosaurs, since the different parts can be suspended and moved easily from one end of the room to the other as well as raised and lowered to suit. But not alone for mounting skeletons, but also for moving, hoisting and turning heavy boxes and heavy specimens it is very useful.

For section cutting and especially for splitting brain cases where brain casts are required we employ a rotary diamond saw. This is a circular blade, made of thin, soft sheet iron, with fine cuts around the edge ($\frac{1}{8}$ inch long and $\frac{1}{8}$ inch apart) in which diamond dust is ground, giving the blade a sharp cutting edge when used with water, which is allowed to drip over the saw when operated. These saws are manufactured in different sizes to suit various purposes. If the diamond set edge has become worn off, the same blade may be used with emery powder. This however leaves a larger cut than the diamond saw does. We use this diamond saw attached to a large lathe. The latter also operates two carborundum wheels for grinding, a drilling or boring machine, a small turning lathe and a rotary saw, for splitting and cutting steel or brass. A two horse power electric motor is sufficient to operate all the appliances just mentioned (Plate LVI).

For forging we have employed a small sized gas-blast furnace (Plate LVI) with a blower which is run by a $\frac{1}{3}$ horse power motor; the forge is powerful enough to heat a two inch steel bar. Wherever compressed air is available the motor-blower becomes unnecessary.

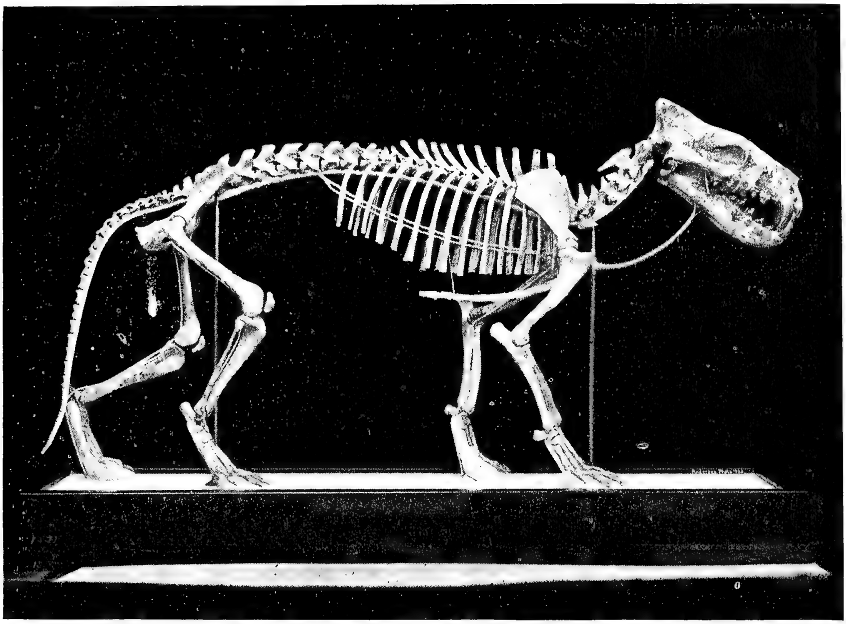
A very useful and almost indispensable tool is the "electric drill." It can be obtained in different sizes for either light or heavy work. In our labora-

[1] Amer. Naturalist, XLII, 1908, pp. 43–47.

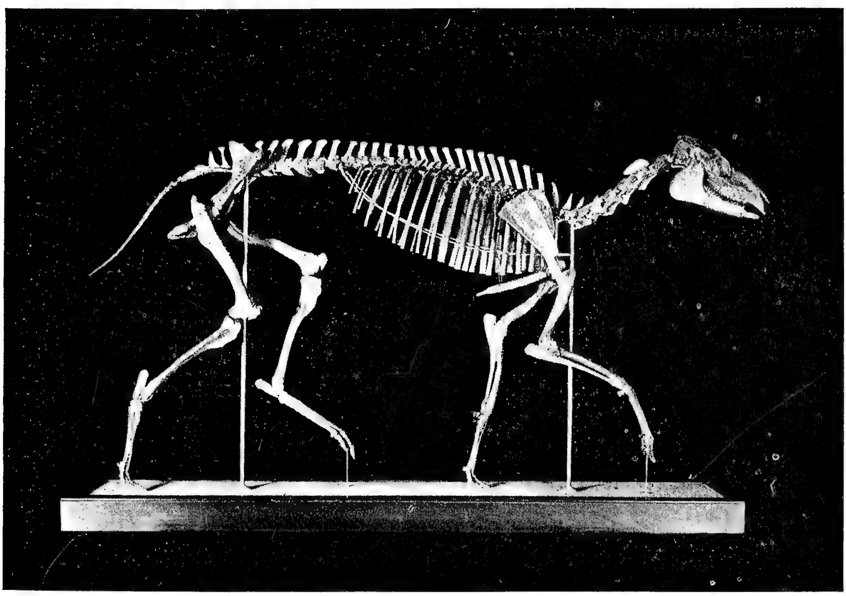
tory we have one in use which weighs eight pounds (about the smallest made). It can be attached to any incandescent light block and bores easily a ¼ inch hole in iron. It is especially advantageous when mounting skeletons in which it often becomes necessary to drill a hole in the iron or in the bone, when in position.

It is understood that the latter tool can only be installed where electricity is available, while any of the other appliances mentioned can be operated by steam-power also.

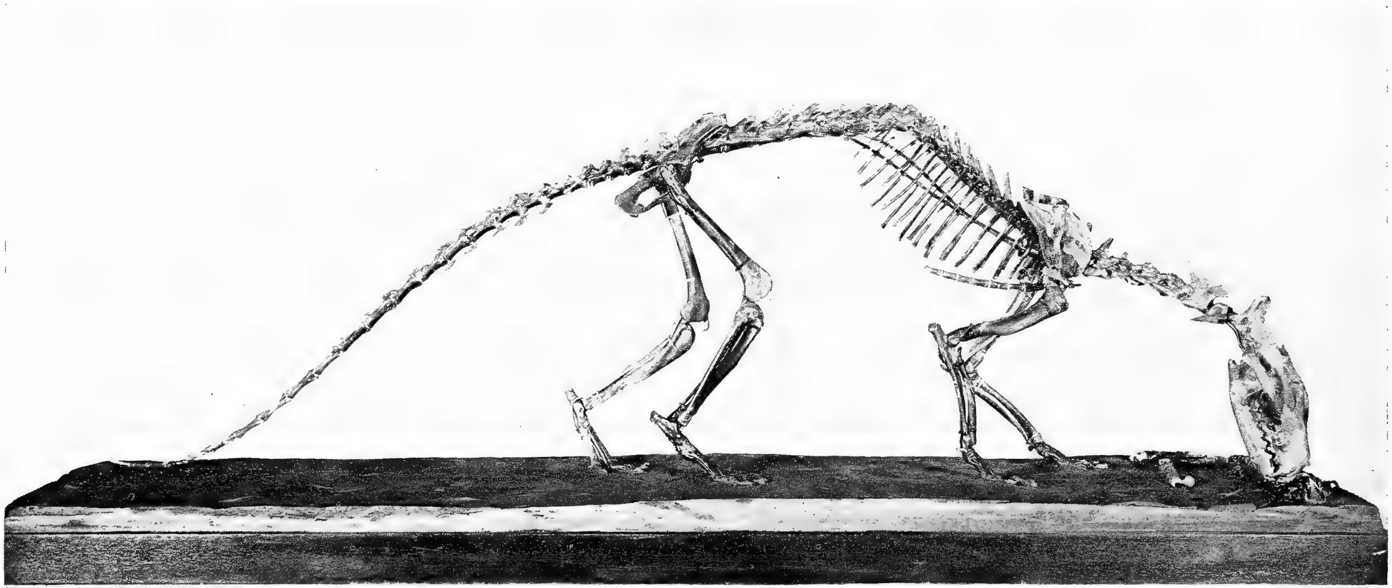
In closing this paper I will say that I have alluded to the most practical methods of preparing, restoring, casting and mounting fossil bones, there are however other ways which are too numerous to mention and which would make this paper too extensive if gone into. A practical palæontologist will overcome difficulties which may occur, by using some ingenuity, since different specimens require different treatment. He must be competent to judge what kind of tools to use for a certain kind of work and how to use them. I therefore say, that a beginner in a palæontological laboratory never ought to be trusted with a delicate and rare specimen. In my experience, I have seen irremediable damage done on account of poor judgment.



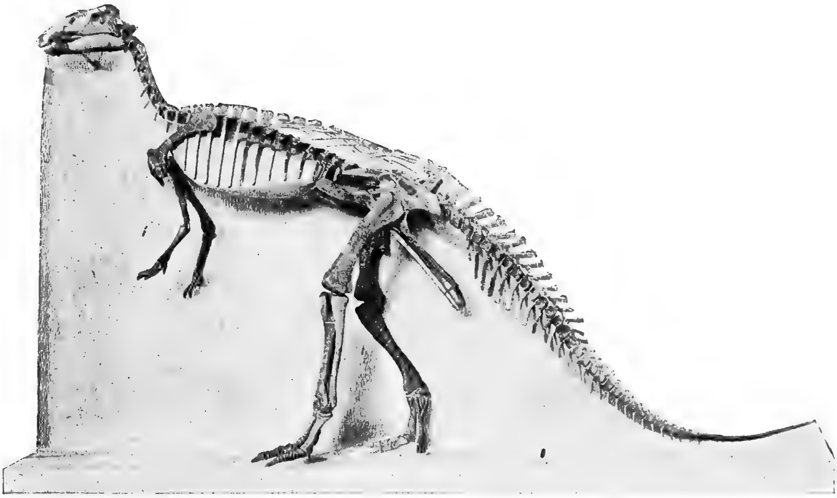
A. *Hyænodon skeleton.* Backbone support of fusible metal, centra of vertebræ free on one side.



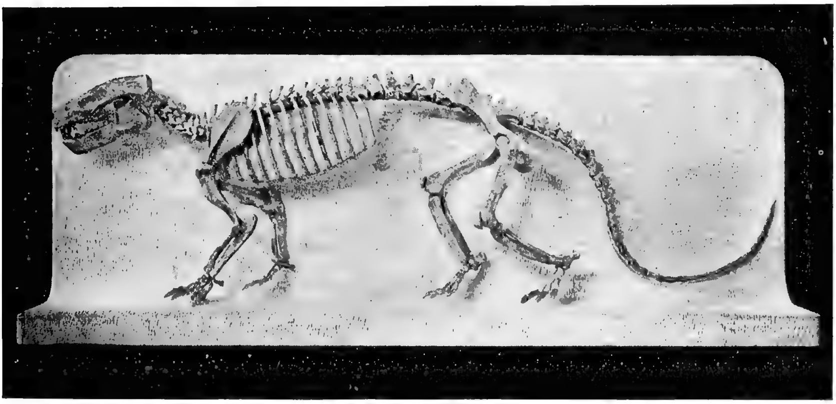
B. *Mesohippus* skeleton. Backbone support running through neural canal, limb supports passing through the bones.



Skeleton of *Tritemnodon*; supported by rods running along the limbs; no uprights.

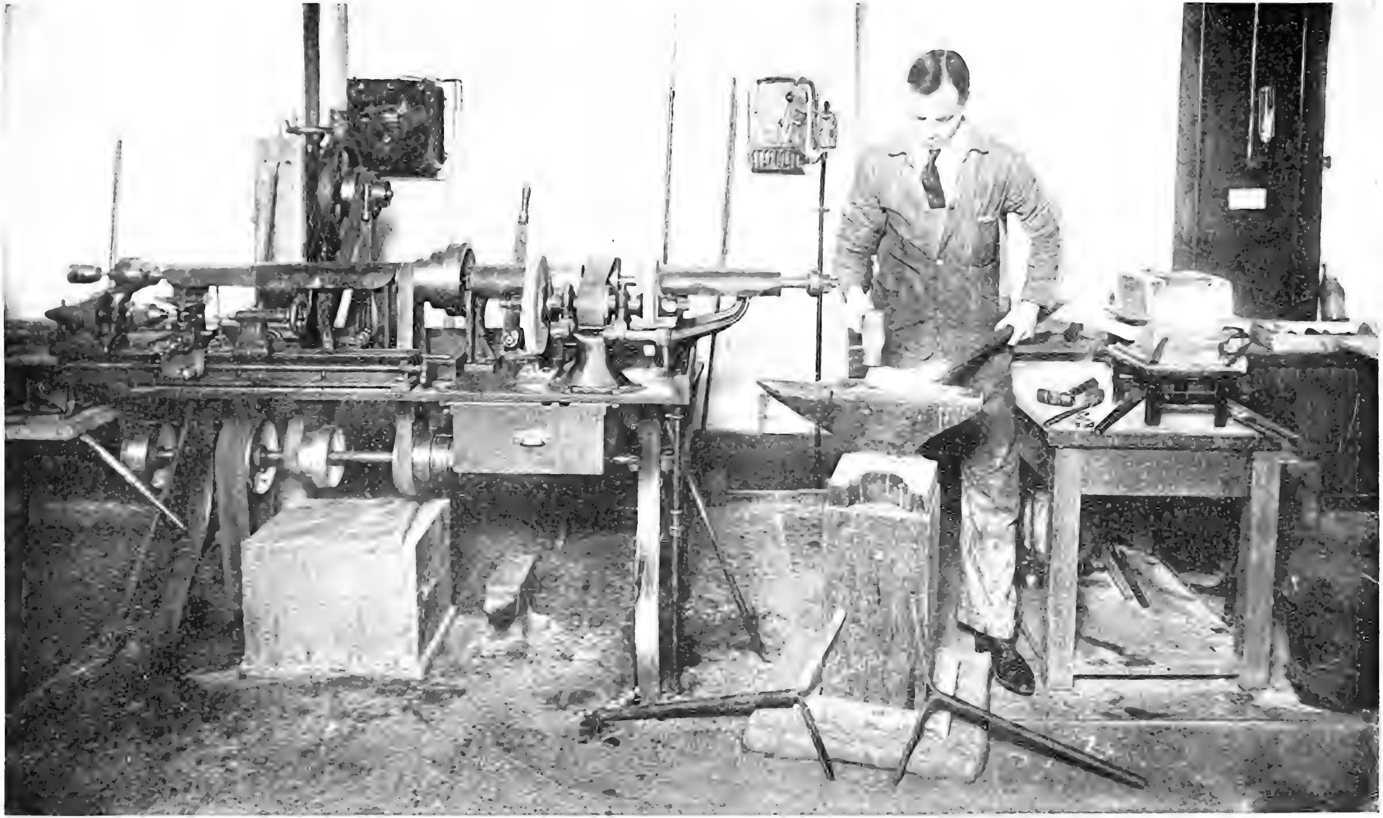


A. Relief mount of *Camptosaurus* skeleton.

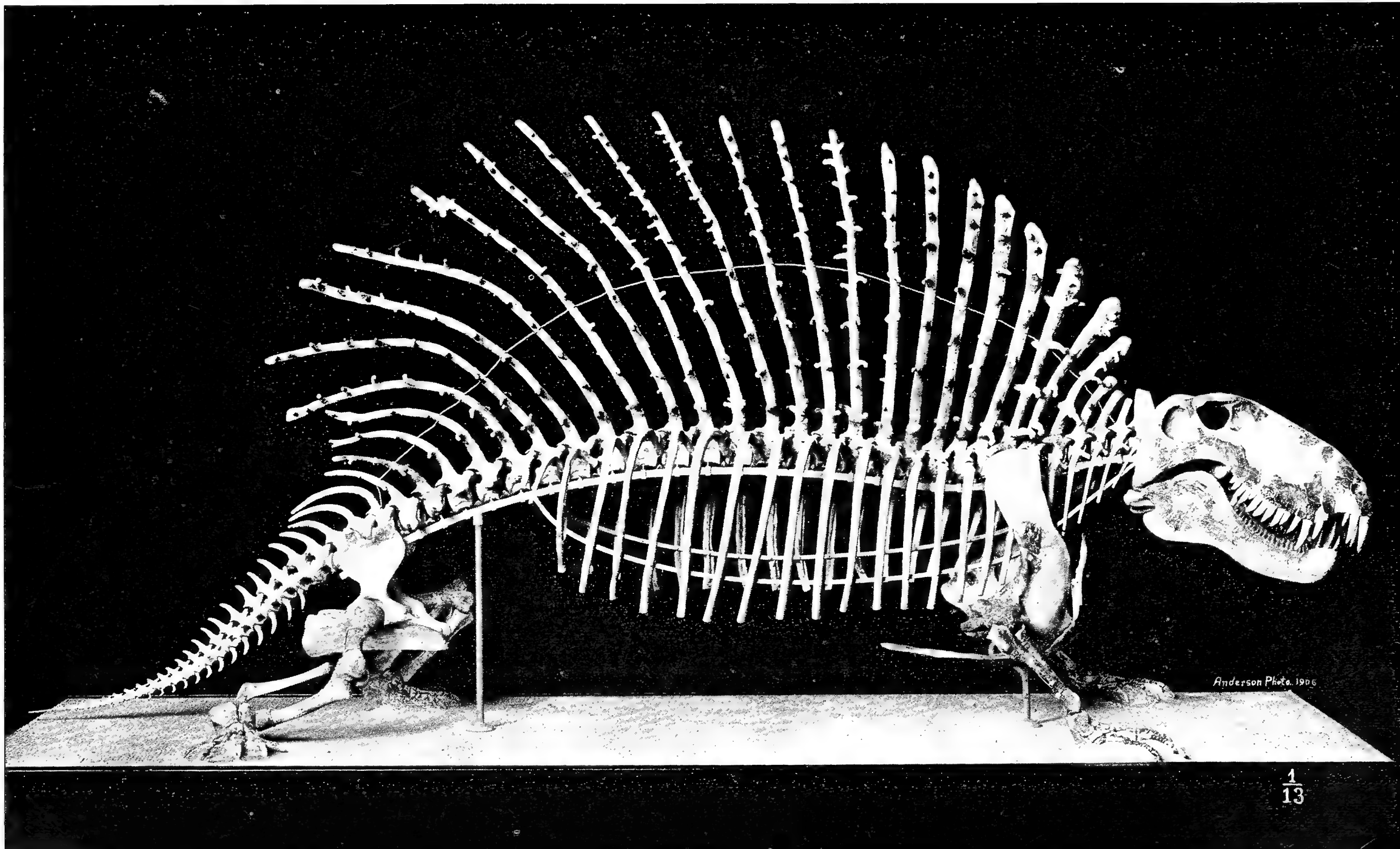


B. Relief mount of *Pantolambda* skeleton.

Trachodon skeleton showing pins for support of vertebræ; suspended from overhead trolley.



Lathe, including appliances for turning, boring, grinding and section-cutting; gas-blast forge and anvil.



Skeleton of *Naosaurus*; all bones bored, with rods inserted.

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Article XXIV.— ANTS OF FORMOSA AND THE PHILIPPINES.

By William Morton Wheeler.

The following lists are based on several small collections of ants that have been received at various times during the past five years by the American Museum of Natural History. The Formosan collection was made by Mr. Hans Sauter in the neighborhood of Takao (Takow) at the southern end of the island and comprises some twenty species, all Indomalayan in character and for the most part already known from other localities such as India, China, Burma, Java, Sumatra, etc. The list is well worth publishing, however, because there seem to be no previous records of ants from Formosa.

Although the Philippines have been frequently visited by collectors, the ant-fauna of these islands has received very little attention. Many years ago Frederick Smith described a few species, without mention of their precise localities in the archipelago,[1] and Emery added a number collected by E. Simon in the island of Luzon.[2] More recently Ashmead attempted to publish a list of the described Hymenoptera of the Philippines,[3] but in enumerating the ants he completely overlooked Emery's contribution and merely recorded a few which he had identified from specimens received from Father W. A. Stanton and the species described by Frederick Smith. It seemed to me advisable and timely, therefore, to prepare a complete list of the species known to occur in the archipelago, including those in the collections of the American Museum of Natural History. These collections were made in several localities by Professor L. E. Griffin of the Missouri Valley University, Dr. E. B. Copeland, of the Government Laboratories at Manila, and Dr. H. M. Smith, of the United States Fish Commission. Nearly all the specimens belong, like those from Formosa, to well-known and widely distributed East Indian species, but they bear accurate locality labels and therefore furnish valuable faunistic information.

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[1] Catalogue of the Hymenopterous Insects in the Collection of the British Museum. Pt. VI. Formicidæ, London, 1858.

[2] Voyage de M. E. Simon aux Îles Philippines. Ann. Soc. Ent. France, LXII, 1893, pp. 259–270, pl. vi.

[3] Descriptions of New Genera and Species of Hymenoptera from the Philippine Islands. Proc. U. S. Nat. Mus., XXVIII, 1904, pp. 127–158, pl. i, ii.

I. Species from Formosa.

1. **Diacamma rugosum** (*Le Guillon*) subsp. **sculptum** (*Jerdon*). Numerous workers. This, and not *D. vagans* F. Smith, is, according to Emery, the common form of the widely distributed *rugosum* in India, Ceylon and Burma.

2. **Monomorium latinode** *Mayr*. Many workers, females and males from several different colonies.

3. **Monomorium destructor** (*Jerdon*). Numerous workers.

4. **Pheidologeton diversus** (*Jerdon*). Numerous females, males and workers of all sizes from several colonies, agreeing perfectly with the well-known Indian form of this species.

5. **Pheidole sauteri** sp. nov.

Soldier. Length 2.75–3 mm.

Head subrectangular, decidedly longer than broad, a little broader in front than behind, with rather sharp anterior angles, deep occipital excision, roundly angular posterior corners and very feebly convex sides. The occipital furrow is deep, with a broad preöccipital impression. Eyes at the anterior fourth of the head. Mentum with two small, acute teeth. Mandibles convex, with two small apical teeth. Clypeus short, with a small but distinct median notch in its anterior border, ecarinate, with a rounded elevation in the middle behind. Frontal area small, triangular, impressed. Frontal carinæ continued back on each side as a low ridge, forming the mesial border of a shallow, flat impression, or scrobe for the antennal scape. This impression is rounded behind, where it terminates half way between the eye and the posterior corner of the head. Antennæ short and slender, scape reaching a short distance behind the eye; joints 2–8 of the funiculus small, subequal, as long as broad; two basal joints of clubs together as long as the terminal joint. Pro- and mesothorax very convex and much higher than the epinotum, rounded or angular in profile, without a torus; seen from above trapezoidal, as broad as long and fully half as broad as the head, with very prominent, subangular humeri. Declivous surface of the mesonotum forming nearly a right angle with the base of the epinotum; meso-ëpinotal constriction deep. Epinotum with subequal base and declivity and a longitudinal median impression; spines acute, half as long as their distance apart at the base, somewhat longer than broad at their base, directed upward and backward. Petiole twice as long as broad, near its posterior end with an anteroposteriorly compressed node, which has a straight upper border. Postpetiole $1\frac{1}{2}$ times as broad as the petiole, broader than long. Gaster elliptical, smaller than the head. Legs moderately long.

Mandibles shining, with small, sparse punctures, and on the outside near the base, with a few coarse striæ. Clypeus smooth and shining in the middle, more opaque and longitudinally rugose on the sides. Head subopaque, with the antennal scrobes uniformly and densely punctate; remaining surface, including the posterior corners, reticulate rugose, with punctate interrugal spaces; front and

anterolateral third of head longitudinally reticulate rugose. Thorax, petiole and postpetiole scarcely more shining than the head, feebly and indistinctly rugulose; meso- and metapleuræ densely punctate. Gaster and legs smooth and shining.

Hairs yellow, moderately abundant; suberect on the body, more reclinate on the legs and scapes.

Reddish-yellow; margins of mandibles, and anterior border of head and clypeus deep red, masticatory border of mandibles narrowly black. Antennæ and legs yellow; gaster sordid yellow with a large black patch on the tergite of each segment.

Worker. Length 1.3–1.5 mm.

Head subrectangular, nearly as long as broad, excluding the mandibles; sides convex, posterior border straight. Mandibles with convex outer borders; inner borders denticulate and with two larger apical teeth. Clypeus convex, with a faintly notched anterior border. Antennal scapes reaching a little beyond the posterior corners of the head and lying in faint depressions representing the scrobes of the soldier. Eyes convex, distinctly in front of the middle of the head. Thorax rather narrow, pro- and mesonotum rounded above and on the sides, but more depressed than in the soldier; torus of mesonotum very feeble; mesoëpinotal constriction rather pronounced. Epinotum with subequal base and declivity, the latter sloping, armed with two teeth which are as long as broad at their bases, but much further apart than long. Petiole more than twice as long as broad, with subparallel sides and an abrupt but rather low node at its posterior end. Postpetiole campanulate, a little broader than the petiole, about as long as broad. Gaster elliptical; distinctly smaller than the head. Legs rather long and robust.

Mandibles smooth and shining, with small, scattered punctures. Clypeus shining but rugulose. Head, thorax, petiole and postpetiole opaque, densely and finely punctate; front of head indistinctly longitudinally rugulose; nodes of pedicel somewhat smooth and shining above. Gaster and legs smooth and shining.

Pilosity and coloration as in the soldier, but the former is shorter and sparser and the head and thorax are somewhat paler and less reddish.

Described from several soldiers and workers from a single colony.

This species is closely related to the other members of an oriental group of *Pheidole* comprising *parva* Mayr, *magrettii* Emery, *capellinii* Emery, *simoni* Emery and *proxima* Forel. The soldier of *sauteri* has a much longer and more rectangular head than that of *parva* of Ceylon and India, the clypeus is notched and the pro- and mesonotum are not densely punctate. The soldier of *magrettii* of Java is larger (3.6–4 mm.), its mesonotum has a transverse ridge and the epinotum is transversely rugulose. The worker is fuscous, with paler legs. The soldier of *capellinii* of Java is even larger (4.75 mm.), has the posterior corners of the head smoother and more shining and the thorax has a different shape and is much more heavily sculptured. In form the soldier of *Ph. proxima* of Australia is very much like that of *sauteri,* but the posterior third of the head is smooth and shining, the antennal scrobes are much feebler, the thorax is more heavily sculptured and the color is paler. Perhaps the species here described is merely a subspecies of *Ph. simoni* Emery from the Philippines. This form, however, has the base of the gaster opaque.

6. **Pheidole javana** *Mayr.* Several soldiers and workers from a single colony.

7. **Pheidole megacephala** (*Fabr.*). Several soldiers, a deälated female and many workers from four colonies.

8. **Cremastogaster rogenhoferi** *Mayr.* Numerous workers swept from vegetation.

9. **Cremastogaster subnuda** *Mayr* var. **formosæ** var. nov.

Worker. Length 2–2.7 mm.

Differing from the typical *subnuda* in its darker color. The head, gaster and legs, with the exception of the tarsal joints, are black; the thorax and pedicel dark brown or blackish, with reddish sutures. It is evidently closely related to the var. *nicevillei* Forel of Calcutta in size and shape, but smaller, much darker and more slender than several of the other varieties and subspecies enumerated from southern Asia by this author (*rabula* Forel, *nilgira* Forel, *notabilis* Forel, *contemta* Mayr).

Five specimens swept from vegetation.

10. **Triglyphothrix striatidens** *Emery.* Two workers.

11. **Iridomyrmex glaber** (*Mayr*). Numerous workers from a single colony.

12. **Tapinoma melanocephalum** (*Fabr*). Many workers and two deälated females from five colonies.

13. **Plagiolepis longipes** (*Jerdon*). Several workers and a deälated female from two colonies.

14. **Plagiolepis mactavishi** *Wheeler.* Ten workers and a deälated female.

15. **Prenolepis longicornis** (*Fabr*). Many workers and two deälated females from three colonies.

16. **Camponotus maculatus** (*Fabr.*) subsp. **taylori** *Forel* var. **formosæ**, var. nov.

Numerous major and minor workers from four colonies seem to represent a variety very near the var. *albosparsus* Forel from the Himalaya. The head of the worker major is dark chestnut brown, opaque and densely punctate, slightly shining on the occipital region and sides. Mandibles and anterior third of clypeus red. Thorax and legs brown, with yellowish sutures and articulations. Gaster black, shining, with yellowish posterior margins to the segments; no yellow spots on the venter, but a pair of yellow spots on the dorsum of the first and another more widely separated pair on the dorsum of the second segment. The first pair is sometimes confluent as in *albosparsus.* The coloration of the worker minor is similar, but the dorsal gastric spots are proportionally larger and more rectangular, the

anterior pair more frequently confluent and the venter of the first and second segments is often yellow. As I have not seen the types of *albosparsus* I am not certain that *formosæ* deserves even varietal rank. Forel mentions another similar variety which is "paler, with the head of the worker minor reddish and the spots on the gaster larger and confluent," from Victoria, Hong Kong.

17. **Camponotus irritans** (*F. Smith*). A single soldier.

18. **Camponotus dorycus** (*F. Smith*). Several workers, major and media, and a winged female seem to represent a variety of this species, but I hesitate to describe them till I am able to compare them with more material of the known forms than I possess at present.

19. **Polyrhachis dives** *Mayr*. A number of workers swept from plants with Diptera and other insects.

20. **Polyrhachis latona** sp. nov.

Worker. Length 5.5 mm.

Head nearly as broad in front as behind, longer than broad and, excluding the mandibles, as high in the region of the frontal carinæ as long; sides subparallel, posterior border evenly and broadly rounded. Eyes convex. Clypeus strongly carinate. Frontal carinæ closely approximated and parallel in front, diverging behind. Antennæ slender. Thorax convex and evenly rounded above, flattened on the sides, nearly as high in the mesothoracic region as long, with distinct promesonotal suture and strong lateral carinæ. From above the thorax is distinctly broader in front than behind, with straight sides. Pronotum $1\frac{1}{2}$ times as broad as long, in front with a pair of acute spines directed forward and very slightly outward, in line with the lateral carinæ. Mesonotum fully three times as broad as long, separated from the pronotum by a distinct notch in the carina on each side and by similar notches from the epinotum. Mesoëpinotal suture absent. Base and declivity of epinotum subequal, the former trapezoidal, nearly as long as broad in the middle, separated from the abrupt and distinctly concave declivity by a straight transverse ridge, terminating at the carina on each side in a small but distinct tooth. Declivity of epinotum abrupt, concave and with a distinct carina on each side continuous with that of the anterior segments. Petiole broader than the epinotum, slightly convex in front, more strongly so behind, its border with a slight median projection in the middle and on each side with two acute, upwardly directed and closely approximated spines, the more mesial of which is long, more tapering and somewhat curved inward, as long as the distance from its base to middle of the upper petiolar border; lateral spine acuminate, not longer than broad at its base. Gaster and legs of the usual shape.

Opaque black throughout, slightly lustrous and densely and finely punctate. Mandibles finely longitudinally striated.

Hairs yellowish, erect and very sparse, confined to the mandibles, clypeus, anterior surface of the fore coxæ and tip of the gaster. Pubescence yellowish gray, densest and longest on the head, thorax and especially on the gaster, where it con-

ceals the surface; more dilute on the pleuræ, legs, antennæ and petiole, so that these parts appear blacker.

Described from two specimens taken in sweepings.

This species is closely related to *P. relucens* Latr., *mayri* Roger and *proxima* Roger. It is smaller than any of these forms, its frontal carinæ are more approximated in front than in *mayri* and *proxima*, the pilosity is very different, the promesonotal and mesoëpinotal notches in the lateral carinæ are not so deep, the pronotal spines diverge less and the mesial petiolar spines are much shorter, not curved backward and nearer to the lateral spines. From *relucens*, *latona* also differs in its more robust and less tapering pronotal and mesial petiolar spines, the straighter transverse epinotal carina, shorter and less dense pubescence and absence of suberect hairs on the thorax and base of the gaster. From *P. connectens* Emery the new species differs in having the epinotum carinate on the sides behind and in the color of the legs; from *labella* F. Smith in the shape of the base of the epinotum, which in this species is barely a third as long as broad, in the color of the tibiæ, etc.

II. Species from the Philippines.

1. **Diacamma rugosum** (*Le Guillon*). According to Emery, F. Smith's *Ponera versicolor* from the Philippines and Sarawak is the typical form of this species. He states that Roger demonstrated this by an examination of Smith's types. The words in the latter's description: "black, with purple, violet and green tints in different lights," lead me to suspect, however, that Smith really had before him specimens of what Emery has more recently called var. *viridipurpureum* (*vide infra*). *D. rugosum,* under Smith's name *versicolor,* is also cited by Ashmead from the Philippines.

2. **Diacamma rugosum** subsp. **geometricum** (*F. Smith*). var. **viridipurpureum** *Emery*. Originally described from Antipolo, Luzon, from two specimens collected by E. Simon. Twenty-three workers from Benguet (H. M. Smith) and four from Bantayan (L. E. Griffin) agree closely with Emery's description of this superb variety, except that the ground color of the legs is black instead of brown.

3. **Diacamma rugosum** subsp. **sculptum** (*Jerdon*). Two workers from Trinidad (H. M. Smith) evidently belong to the typical form of this subspecies, which occurs also in Burma, India and Ceylon. Two other specimens received from Ashmead and collected at Manila by Rev. W. A. Stanton are somewhat larger and more robust, blacker and with coarser sculpture, but may also be assigned to this subspecies.

4. **Diacamma rugosum** subsp. **sculptum** var. **vagans** (*F. Smith*). To this variety I refer six workers from Papagon Island (H. M. Smith). The cephalic striæ are rather faint in some specimens, stronger in others, arcuate and converging to the frontal carinæ behind the antennal insertions. The semicircular striæ on the first gastric segment are faint and, on the sides and posterior border of the segment, obsolete. The pubescence is not abundant and the hairs are very short and sparse. The body is blackish bronzed, the metallic reflection being most pronounced on the gaster. The legs, mandibles and antennæ are chestnut brown. Length 9–10 mm.

5. **Odontoponera transversa** (*F. Smith*). This species is cited by Emery from Antipolo, Luzon. Two workers were taken at Bantayan by L. E. Griffin.

6. **Leptogenys** (**Lobopelta**) **diminuta** (*F. Smith*) var. A single worker from Papagon Island (H. M. Smith) approaches the typical Indian form of the species in the sculpture of the head, but the thorax is more like that of the Ceylonese var. *sarasinorum* Forel. It probably represents a new variety, but the material is insufficient for description. It is certainly not the subsp. *striatula* Emery, which has the petiole broader than long and the sutures surrounding the mesonotum more distinct than in the typical form. The true *diminuta* is recorded by Forel from Salak, Java, and by Emery from several localities in Sumatra.

7. **Euponera** (**Brachyponera**) **luteipes** *Mayr*. Recorded by Emery from Antipolo, Luzon. Forel mentions its occurrence at Buitenzorg, Java.

8. **Bothroponera glabriceps** *Emery*. This species, which is very closely related to *B. tesserinoda* Mayr, is based on specimens from Mindanao.

9. **Odontomachus hæmatodes** *L*. Recorded by Emery from Manila.

10. **Odontomachus infandus** *F. Smith*. This species was originally described from the "Philippine Islands." Emery records it from Antipolo, Luzon, and Ashmead includes it in his list of Philippine ants.

11. **Odontomachus papuanus** *Emery* subsp. Emery mentions this from Manila but does not describe it.

12. **Odotomachus sævissimus** *F. Smith*. Nine workers from Romblon (H. M. Smith) agree very closely with Smith's original description of this species.

13. **Sima allaborans** (*Walker*). Emery cites this species from Manila, Antipolo and Quruña, and Ashmead also mentions it from the Philippines.

14. **Monomorium destructor** (*Jerdon*). Cited by Emery from Manila and Antipolo.

15. **Monomorium pharaonis** (*L.*). Numerous workers and deälated females from Bais, Negros Oriental (L. E. Griffin).

16. **Monomorium gracillimum** (*F. Smith*). Many workers of the typical

Burmese form from a locality between Sablon and Naguillan, Luzon (H. M. Smith).

17. **Solenopsis geminata** (*Fabr.*) var. **rufa** (*Jerdon*). Numerous workers from Bais (L. E. Griffin) are recognizable as belonging to this variety on account of their red color and the spine on the mesosternum. Emery cites *S. geminata* from Manila and Antipolo, and it is probable that his specimens also belonged to this South Asiatic variety and not to the typical form of the species, which lives in the West Indies and the adjacent American tropics.

18. **Pheidologeton diversus** (*Jerdon*). Recorded by Smith under the name *Pheidole ocellifera* from "Burmah, Hong Kong, Philippine Islands." It is also cited by Ashmead from the locality last mentioned.

19. **Pheidologeton pygmæus** *Emery* var. **albipes** *Emery*. Originally described by Emery from worker specimens taken by Simon at Antipolo, Luzon.

20. **Pheidole simoni** *Emery*. Described by Emery from a single soldier taken at Manila. It resembles *Ph. sauteri* from Formosa (*vide supra*) very closely, but has longer antennal scapes and the base of the gaster is opaque.

21. **Pheidole** sp. A form "allied to *Ph. longicornis* and *velox* Emery," of which Emery saw only a single worker from Antipolo.

22. **Cremastogaster ochracea** *Mayr*. Recorded by Emery from Antipolo, Luzon.

23. **Cremastogaster simoni** *Emery*. Originally described from worker specimens taken by Simon at Manila and Antipolo.

24. **Cremastogaster semperi** *Emery*. Like the preceding originally described from specimens taken at Manila by Simon.

25. **Cremastogaster longiclava** *Emery*. The types of this species were taken by Simon at Antipolo.

26. **Cremastogaster crassicornis** *Emery*. Types from Manila, collected by Simon. These resemble *C. brevis* Emery of Java.

27. **Cremastogaster bicolor** *Mayr* var. **imbellis** *Emery*. Described from single worker and female specimens taken at Manila and Antipolo by Simon.

28. **Tetramorium pacificum** *Mayr* subsp. **subscabrum** *Emery*. The worker of this subspecies was originally described from Antipolo, but, according to Emery, it occurs also in Ceylon and New Caledonia.

29. **Tetramorium guineense** (*Fabr.*). Numerous workers and deälated females of this common tropicolitan form were taken at Bais by L. E. Griffin. It is also recorded from the Philippines by Ashmead.

30. **Myrmicaria subcarinata** (*F. Smith*). A single worker taken at Benguet, Luzon (H. M. Smith) belongs to this species but differs from

typical specimens in having the longitudinal ridges on the epinotum connected by equally prominent transverse ridges. The gray hairs on the body and appendages are long and abundant. The material is not sufficient to permit of the establishment of a new variety.

31. **Myrmicaria** sp. Two males received from Ashmead and collected by P. I. Stangel at Bay Laguna, Philippines, are labelled "*M. philippinensis* Ashmead," apparently a MS. name. This species should not be recognized as the specimens are probably males of *subcarinata* or of some other well-known species of the genus.

32. **Dolichoderus bituberculatus** (*Mayr*). Several workers and females from Zamboanga Forest, Mindanao (E. B. Copeland), a whole colony comprising males, females and workers, taken in a bunch of grapes at Bantayan (L. E. Griffin), and a number of workers taken by H. M. Smith, at Santa Cruz Laguna ("in decaying cocoanut-wood"), San Miguel Harbor, Ticao Island, Benguet and Ramblon. This species, which is common in India, Burma, Java and Sumatra, is also recorded by Ashmead from the Philippines and by Emery from Manila, Antipolo and Quruña.

33. **Iridomyrmex glaber** (*Mayr*). Three workers from Bais (L. E. Griffin).

34. **Iridomyrmex smithi** sp. nov.

Worker. Length 2.5–3 mm.

Head longer than broad, elliptical, as broad in front as behind. Mandibles rather slender, minutely denticulate. Clypeus flattened, with a broad, shallow, median excision in its anterior border. Frontal area large, triangular, convex. Frontal groove absent. Eyes rather large and prominent. Antennæ long and robust; scape reaching fully ⅓ its length beyond the posterior border of the head; funicular joints cylindrical, all at least twice as long as broad. Thorax slender, resembling that of *I. anceps* Mayr in shape, but the epinotum more convex and abruptly rounded in front. Pronotum moderately convex, as long as broad, through the humeri a little narrower than the head. Mesonotum narrow, cylindrical, a little broader behind than in front, nearly as long as the pronotum, with nearly straight sides, in profile with sloping, feebly convex upper surface, continuing the curve of the pronotum. Epinotum somewhat broader than the mesonotum, as high as long, with abruptly convex base, especially in front, and somewhat flattened, sloping declivity. Petiole small, narrow, longer than broad, subelliptical, with the node very low and inclined forward, its posterior surface flat and gently sloping. Gaster of the usual shape. Legs long.

Whole body, including the legs and scapes, subopaque, rather densely and finely punctate; epinotum and mesopleuræ with coarser punctures, those on the mandibles large and sparse.

Hairs and pubescence yellowish-gray, long and rather abundant, the former suberect on the body, scapes and legs, the latter longest and most conspicuous on the gaster.

Black; funiculi and mandibles reddish-brown, the latter with yellowish borders; articulations, spurs and tarsi of legs yellow.

Female (deälated). Length 3.4 mm.

Resembling the worker, except in the structure of the thorax and the somewhat paler color of the mandibles and antennal funiculi. The mesonotum is transversely impressed behind, the epinotum rather low and rounded, without distinct basal and declivous surfaces; the petiolar node is very low and blunt. Wing articulations yellow.

Described from eight workers and a single female taken on Ramblon Island (H. M. Smith).

This species is related to *I. lævigatus* Emery and *anceps* Mayr but differs from both in the shape of the head and epinotum, in pilosity, sculpture and in its somewhat smaller size.

35. **Tapinoma melanocephalum** (*Fabr.*). Numerous workers from Bais (L. E. Griffin). Also recorded by Emery from Manila and Antipolo.

36. **Technomyrmex albipes** (*F. Smith*). Recorded by Emery from Manila, and also mentioned by Ashmead as occurring in the Philippines.

37. **Plagiolepis longipes** (*Jerdon*). Many workers from Bais (L. E. Griffin) and a single specimen from Santa Cruz Laguna, Manila (H. M. Smith).

38. **Prenolepis** sp. A single winged female from Santa Cruz Laguna (H. M. Smith). It cannot be identified without the males or workers.

39. **Œcophylla smaragdina** (*Fabr.*). Cited by F. Smith from the Philippines. Several workers in my collection, bearing the same general locality label (H. M. Smith), are indistinguishable in structure from typical specimens collected in India and Cochin China and do not therefore belong to the following variety.

40. **Œcophylla smaragdina** var. **subnitida** *Emery*. A form of this variety, originally described from New Guinea and the Island of Morotai, is recorded by Emery from Antipolo, Luzon. This form approaches the Australian subsp. *virescens* (Fabr.) in the shape of the head, which is more rounded behind than in the typical *subnitida*.

41. **Camponotus gigas** (*Latr.*). This, the largest of all known ants, is recorded by Ashmead from the Philippines. It has long been known from adjacent Indomalayan regions.

42. **Camponotus maculatus** (*Fabr.*) subsp. **mitis** *F. Smith* var. **crassinodis** *Forel*. Several workers and a deälated female from Bais (L. E. Griffin). The major workers are almost indistinguishable from a Burmese type specimen given me by Professor Forel.

43. **Camponotus pallidus** (*F. Smith*). Mentioned by Ashmead as occurring in the Philippines.

44. **Camponotus pallidus** var. **subnudus** *Emery*. Recorded by Emery from Manila.

45. **Camponotus** sp. An undescribed species belonging to the *maculatus* group, but represented only by a single worker minor, is recorded by Emery from Antipolo.

46. **Camponotus herculeanus** *L.* subsp. **japonicus** *Mayr.* A female specimen from Mindanao is referred to this northern subspecies by Emery.

47. **Camponotus cinerascens** (*Fabr.*). Mentioned by Ashmead as occurring in the Philippines.

48. **Camponotus corallinus** *Roger.* This species was described by Roger from Manila and referred to *Colobopsis.* It seems not to have been seen since and Emery leaves its position in the great series of *Camponoti* in doubt.

49. **Camponotus pubescens** *Mayr.* This species also belongs to the subgenus *Colobopsis* in the broad sense. It is recorded by Emery from Manila.

50. **Camponotus nigricans** *Roger.* Originally described from a single female, taken in Manila, as a variety of *platypus* Roger. Emery records a worker from Iolo.

51. **Camponotus platypus** *Roger.* This was described from female specimens taken at Manila. Emery records it also from Mindanao. Workers are unknown.

52. **Camponotus quadrisectus** (*F. Smith*). The types (female) of this species are also from the Philippines. Emery saw a specimen of the same sex from Mindanao. There are three major workers from Manila (H. Viehmeyer) in the collection of the American Museum.

53. **Polyrhachis thrinax** *Roger* subsp. **saigonensis** *Forel.* Recorded by Emery from Manila and Antipolo.

54. **Polyrhachis thrinax** subsp. **javana** *Mayr.* Recorded by Emery from Quruña, Luzon.

55. **Polyrhachis philippinensis** *F. Smith.* The types of this species, as the name indicates, were from the Philippines.

56. **Polyrhachis mayri** *Roger.* Recorded by Ashmead from the Philippines.

57. **Polyrhachis diana** sp. nov.

Worker. Length 5–5.5 mm.

Head longer than broad, about as broad behind as in front and nearly as high through the frontal carinæ as long, with rather straight, subparallel sides and broadly rounded posterior border. Eyes large, very prominent. Clypeus somewhat depressed, carinate. Frontal carinæ very prominent, closely approximated in front, further apart behind but scarcely diverging. Thorax broader in front than behind, with flattened sides, strongly carinate above on the sides, fully as high through the mesopleuræ as long, evenly convex above in profile. Pronotum fully $1\frac{1}{2}$ times as

broad as long, with a pair of straight acute spines, directed forward and slightly outward and continuous behind with the lateral carinæ. These are interrupted by rather deep notches at the boundary between the pro- and meso-, and between the meso- and epinotum. Promesonotal suture distinct, mesoëpinotal suture feebler, especially in the middle. Mesonotum four times as broad as long. Base of epinotum convex, trapezoidal, less than twice as broad as long, separated from the steep, concave and somewhat longer declivity by a prominent transverse ridge which terminates on each side in a short, blunt tooth in the lateral carina. This carina is continued down the side of the declivity and ends in a small swelling just above the metasternum. Petiole broad, anteroposteriorly compressed, convex in front, flattened behind, thickened below, with a broadly and evenly rounded upper margin, and with two approximated spines on each side. The mesial spine is tapering, pointed, much shorter than half the median border of the petiole and curved outward and backward so that it clasps the base of the gaster. The lateral spine is a mere tooth, acute but not longer than broad at the base. Gaster and legs of the usual shape.

Body black throughout, apparently opaque and finely punctate or shagreened, but so thickly and uniformly overlaid with dense, appressed, silvery pubescence that the surface is invisible. The pubescence on the legs and antennæ is shorter and more dilute so that these parts appear blacker. Hairs white, very sparse, short, and confined to the mandibles, clypeus and tip of the gaster.

Six workers from Butuan, Mindanao (H. M. Smith.)

This species is closely related to *P. latona* described above, but is easily distinguished by its more abundant and silvery pubescence, shorter thorax and the different shape of the petiole and its spines. It differs from the other members of the *relucens* group enumerated under the description of *latona* in the same characters as that species.

58. **Polyrhachis cyaniventris** *F. Smith.* Originally described from the Philippines.

59. **Polyrhachis maligna** *F. Smith.* The types of this species were also from the Philippines.

60. **Polyrhachis murina** *Emery.* Recorded by Emery from the Philippines.

61. **Polyrhachis pubescens** *Mayr.* Recorded by Emery from Antipolo, Luzon.

62. **Polyrhachis rastellata** *F. Smith.* Mentioned by Ashmead as occurring in the Philippines.

63. **Polyrhachis bihamata** (*Drury*). Six workers from the Zamboanga Forest, Mindanao (E. B. Copeland). Emery records it from Antipolo, and Ashmead includes it in his list of Philippine Hymenoptera.

64. **Polyrhachis bellicosa** *F. Smith.* Mentioned by Ashmead as occurring in the Philippines.

65. **Polyrhachis armata** (*Guill.*). Two workers from the Zamboanga Forest (E. B. Copeland). This species is also cited by Ashmead.

66. **Polyrhachis sexspinosa** (*Latr.*). F. Smith described specimens of this species from the Philippines.

67. **Polyrhachis abdominalis** *F. Smith.* Cited by Ashmead.

68. **Polyrhachis abdominalis** var. **reversa** *Ern. André.* The types of this variety are from the Philippines.

69. **Polyrhachis bicolor** *F. Smith.* Recorded by Emery from Antipolo, Luzon. Also mentioned by Ashmead as occurring in the Philippines.

70. **Polyrhachis argentea** *Mayr.* Recorded by Emery from Manila and Antipolo.

71. **Polyrhachis dives** *F. Smith.* A single worker from Trinidad, Philippines (H. M. Smith). Recorded also from Manila by Emery.

72. **Polyrhachis aciculata** *F. Smith.* This species, long ago described from the Philippines, has not since been seen by myrmecologists. Emery includes it among the species *incertæ sedis.*

56.76(115:7)

Article XXV.— NEW OR LITTLE KNOWN FORMS OF CARBONIFEROUS AMPHIBIA IN THE AMERICAN MUSEUM OF NATURAL HISTORY.

By Roy L. Moodie.

University of Kansas.

Plates LVIII–LXV.

There have been, up to the present time, about eighty species of Amphibia recognized in the Carboniferous of North America. The known forms represent a fauna of extreme diversity of appearance and structure.

The genus *Tuditanus* was among the first to be characterized by Professor Cope [1] in his studies of the Carboniferous forms. He based his description of the genus on the two species, *T. punctulatus* and *T. brevirostris.* He later referred to the same genus such forms as *T. huxleyi, T. radiatus, T. tabulatus, T. obtusus,* etc., and on account of the more striking form of the latter species the genus *Tuditanus* is usually thought of as pertaining to the larger species. The form *T. huxleyi* has already been separated by the writer into a distinct genus, *Macrerpeton.*[2]

The forms *T. radiatus* and *T. tabulatus* show characters which are so diverse from those exhibited by the species designated by Cope as the types of the genus *Tuditanus* that in the hopes of gaining a more consistent view of these forms the new genus *Erpetosaurus* is proposed to include them as well as other members of the genus *Tuditanus* which are aberrant to the type forms. I will designate *T. radiatus,* Plate LXII, Fig. 1 (American Museum No. 8600 G), as the type of the new genus and with this species are to be associated the two new forms described below and also: *Erpetosaurus* (*Tuditanus*) *tabulatus* (Cope), Plate LXII, Fig. 2, *Erpetosaurus* (*Tuditanus*) *sculptilis* (Moodie), *Erpetosaurus minutus* Moodie, *Erpetosaurus* (*Dendrerpeton, Tuditanus*) *obtusus* (Cope), There will thus be established two definite morphological groups which have distinctive characters. The genus *Tuditanus* will contain the following species: *T. punctulatus* Cope, *T. brevirostris* Cope, *T. longipes* Cope, *T. minimus* Moodie, *T. walcotti* Moodie.

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[1] Cope, E. D. Trans. Amer. Philos. Soc., Vol. XV, p. 271.

[2] Moodie, Roy L. Journal of Geology, Vol. XVII, No. 1, p. 72.

Erpetosaurus, new genus.

The characters on which this new genus is based are the large size of the individuals, the coarse sculpture of the cranial elements, the arrangement of the cranial elements, the larger size and relatively more anterior position of the orbits, and the presence on the skull of a distinctive type of lateral line system (Fig. 1). The position as to family is a little uncertain since family characters are not yet well understood among the Carboniferous forms on account of the lack of information as to the structure of the animals. If we take the absence of ventral scutellæ as a family character then the present genus will find its place in the Tuditanidæ; but the evidence on this point is negative so that for the present we may place the species of *Erpetosaurus* only provisionally among the Tuditanidæ. This arrangement will undoubtedly require revision when additional material will allow a closer definition of the genus.

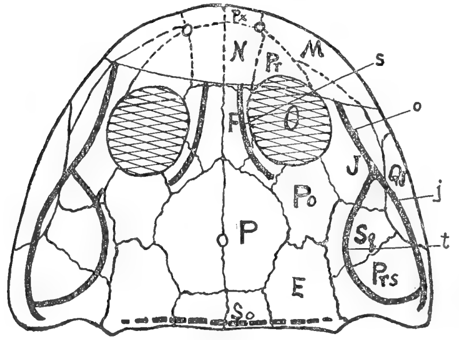

Fig. 1. Outline of the skull and cranial elements of *Erpetosaurus tabulatus* (Cope), showing the arrangement of the lateral line canals. × 1.5.

E = epiotic; *F* = frontal; *J* — jugal; *M* = maxilla; *N* = nasal; *O* = orbit; *P* = parietal; *Po* = postorbital; *Pr* = prefrontal; *Prs* = supratemporal; *Px* = premaxilla; *Qj* = quadratojugal; *Sq* = squamosal; *So* = supraoccipital; *s* = supraorbital lateral line; *o* = suborbital lateral line; *j* = jugal canal; *t* = temporal canal. The row of elongate dots across the base of the skull represents the occipital cross commissure.

The new genus may be defined as follows: —

Skull stout, elements sculptured with radiating grooves and ridges or pits; orbits large and usually placed far forward; base of skull sometimes provided with a posterior table; skull more or less rounded; lateral line canals consisting of supraorbitals, *s*, suborbitals, *o*, jugals *j*, and temporal, *t* (Fig. 1), canals with the last two uniting to form a circular canal in one species (E.). Type, No. 8600 G, Amer. Mus.

Our knowledge of the genus is confined exclusively to the skull.

Erpetosaurus tuberculatus n. sp.

Plate LVIII.

The present species is based on a fragmentary cranium consisting of the posterior part of the right side of the skull. Its association in the genus is solely on the character of the sculpturing of the cranial elements. It is

most closely related, in the characters which are preserved, to the form described by Cope as *Tuditanus radiatus* from which it differs especially in the character of the sculpture and in the position of the orbits, as well as the arrangement and size of the various cranial elements, so far as this arrangement can be determined in the present specimen. In *Erpetosaurus radiatus* (Cope) the skull is sculptured by radiating grooves and ridges (Plate LXII, Fig. 1), which do not rise from any definite center. In *E. tuberculatus* this center of radiation is marked by an elevation or tubercle on each cranial element exposed, from which the grooves and ridges radiate outward. These tubercles have an elevation of four millimeters above the cranial element proper. The orbit (Plate LVIII, *O*), is located near the median line of the skull so far as can be determined. In *E. radiatus* the orbits are located well forward. In that species also the supraoccipital is smaller than in the present species and the squamosal is longer and more slender.

The fragment of the skull on which the above comparison has been made consists of the left supraoccipital plate, a portion of an epiotic, the parietal, the frontal and a portion of the squamosal. The jugal and supratemporal elements have been lost. The elements in the median line are elongated as in *E. radiatus*. The pineal foramen is located well back on the median line and lies posterior to two-thirds of the length of the parietals. The sutures separating the frontal and parietal elements from each other in the median line are of the zigzag form so characteristic of the higher labyrinthodonts.

Measurements of the type of *Erpetosaurus tuberculatus* Moodie.

	mm.
Length of portion of skull preserved	52
Width across epiotics (estimated)	60
Length of parietal	12
Width of parietal, maximum	11
Length of frontal	25
Width of frontal	12

A single specimen with its counterpart, Nos. 8603 G and 8610 G, is in the Newberry Collection of the American Museum.

Erpetosaurus acutirostris n. sp.

Plate LXI, Fig. 1.

The present species adds another form to the diversity of structure presented by the Carboniferous Microsauria. It is closely allied to *Erpetosaurus* (*Tuditanus*) *obtusus* (Cope), Fig. 2 and Plate LX, Fig. 2, from the same beds but differs from it especially in the position and shape of the

orbits and the acute form of the skull. Other characters, which amount almost to generic significance, are found in the posterior prolongation of the frontal and in the triangular form of the skull. Only the skull of the animal is preserved and this is shown in Plate LXI, Fig. 1, where the various elements of the cranium are indicated by letters. The character which is common to all members of the genus *Erpetosaurus,* the cranial rugosity, is present in this species on the squamosal and supratemporal. This character alone would not, however, suffice to separate the form generically, but the general morphology and arrangement of the cranial elements is such that reference to any other genus save *Erpetosaurus* would not be legitimate.

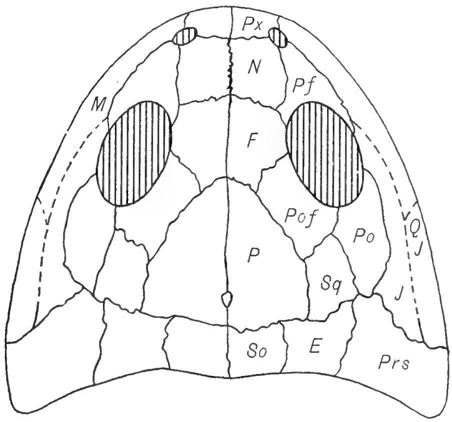

Fig. 2. Outline of the skull and cranial elements of *Erpetosaurus obtusus* (Cope). × 1. Legends for the cranial elements as in Figure 1.

The skull of *Erpetosaurus acutirostris* takes the form of a rounded triangle. Its base is some 50 millimeters in extent and this width gradually narrows to 31 millimeters across the orbits and still more towards the snout. The form of the skull is not widely different from that of the type species, *E. radiatus* (Cope), but the differences are sufficiently apparent. (Compare Plate LXI, Fig. 1, and Plate LXII, Fig. 1.)

Nearly all the elements of the cranium can be detected and by careful study of the figure (Plate LXI, Fig. 1) the outlines of the cranial elements will become apparent to the reader. The bony portion of the cranium has nearly all been lost leaving only the impression; and the matrix in which the skull was imbedded has been forced up into the sutures between the cranial elements, thus forming ragged ridges where the bones of the skull were joined.

The position of the nostrils cannot be determined accurately. The orbits are placed well forward, a character common to several species of the genus. The interorbital space is equal to the long diameter of the eye. The orbits are separated by narrow prolongations of the postfrontals and by the anterior portions of the frontals. The frontals are remarkable in their great backward extension. In *E. obtusus* (Cope) the frontals are nearly confined to the interorbital space. The parietals, which, on the median

suture, enclose the parietal foramen, lie well posterior, and the supraoccipitals and epiotics are small. A portion of the sculpturing of these elements has been preserved and it is seen to be made up of pits and elevations much as we find in the skull of *Saurerpeton latithorax* (Cope). The left squamosal also shows sculpturing which here tends to take the form of grooves and ridges and also pits and elevations. It is quite probable that the anterior portion of the skull was ornamented with grooves and ridges and undoubtedly the lateral line canals were well developed. The postfrontals and the postorbitals are both large and elongated. The postorbital is especially large. The squamosal apparently separates the epiotic and the supratemporal in their posterior extremities but of this I am not sure. The supratemporal, *u*, projects posteriorly to the epiotic and apparently even goes beyond the limits of the exoccipitals, *x*. The region of the quadratojugal is indicated at *i*. Its presence is, however, not definitely determined. The outlines of the jugal, *j*, are fairly definite as are also the limits of the maxilla, *m*.

Measurements of the type of the skull of *Erpetosaurus acutirostris* Moodie.
(No. 8598 G, American Museum).

	mm.
Length of skull	50
Interorbital space	9
Width of orbit	7
Length of orbit	10
Width across orbits	31
Posterior width of skull	50
Diameter of pineal eye	1
Length from tip of snout to posterior angle of the skull	65

Mandible provisionally associated with **Erpetosaurus tabulatus** (Cope).

Plate LX, Fig. 2, and Plate XIV, Fig. 3.

The present specimen is preserved almost completely on a small slab of soft coal. It is impossible to determine with positiveness to what species of the Microsauria it pertains but it may, for the present, be associated with *Erpetosaurus tabulatus* (Cope), Plate LXII, Fig. 2, on account of its size and the character of its sculpture. It is a rare treat to have such an excellent opportunity to study the mandible of a microsaurian and, so far as I am aware, this is the first and most complete example we have of the mandible in the North American Microsauria. The form of the jaw is perfectly preserved although the exact structure of the articular surface cannot be determined. An enlarged photograph is given in Plate LX, Fig. 2, and the

mandible is shown natural size in Plate LXIV, Fig. 3. A glance at either will suffice to give the essential characters.

The proportions of the mandible, as may be judged from the table of measurements, are rather stout and the teeth are strong and numerous since there are evidences of nineteen preserved. The sutures separating the articular, *a*, angular, *n*, surangular, *s*, coronoid, *c*, and the dentary, *d*, are clear for at least the greater part of their length and they may be easily restored for the remainder of their course. The surangular is thus seen to rival the dentary in size and on it occurs the peculiar sculpturing which approximates so closely that on the skull of *Erpetosaurus tabulatus* (Cope). The presence of the long anterior tooth is strikingly characteristic of the early microsaurians. It is well developed, for instance, in *Sauropleura longidentata* Moodie. It is also present in well developed form in several species of the later labyrinthodonts. The teeth are all, with the exception of the fourth from the anterior end, rather short, curved and sharply pointed with an indication of longitudinal fluting. The arrangement of the mandibular elements recalls in a striking way the mandible of *Eryops* as figured by Branson.[1]

Measurements of the mandible provisionally associated with *Erpetosaurus tabulatus* (Cope).

	mm.
Length of mandible	32
Posterior width across surangular	6
Width of dentary	3
Width of jaw at tip	1.5
Length of one of the posterior teeth	1.25
Width at base of same tooth	.50
Length of long anterior tooth	2
Width of do. at base	.75

This specimen is in the Newberry Collection of the American Museum of Natural History, No. 8542 G.

Palate of **Erpetosaurus** sp.

Plate LX, Fig. 2.

The form designated above is represented by half of a cranium with its impression. Its reference to the genus *Erpetosaurus* is based on the character of the sculpturing of the mandible and on the form of the posterior table of the skull. On the surangular there is seen the rugosity which is common to other members of the genus. The sculpture is similar to that exhibited

[1] Branson, E. B. Journal of Geology, Vol. XIII, No. 7, p. 603.

by the mandible described above as pertaining to *Erpetosaurus tabulatus* (Cope), and the posterior table of the skull is strikingly as in that species (Plate LXII, Fig. 2). Its reference to that species was, however, uncertain on account of the greater size of the present specimen.

The portion of the skull herewith described may represent a new form but I hesitate to name it since the characters on which all of the other members of the genus are based have been confined to the dorsal region of the skull. The present specimen and its counterpart are especially interesting and unique in showing, very clearly, so far as the specimen is preserved, the structure of the elements of the palate, the only instance in which this structure has been possible of observation among several score specimens. Jaekel has figured, very completely, the palate of *Diceratosaurus punctolineatus* Cope. The morphology of the present palate differs from that of *Diceratosaurus* only in the enlarged ectopterygoid which in the present instance lies well down on the side and along the pterygoid. The palatine is smaller.

The parasphenoid (vomer of Broom) in the present form does not differ, so far as I can determine, from the parasphenoid exhibited by other Palæozoic Amphibia. Its form was slender, arising from an enlarged base and separating the pterygoids by its own width. The exoccipitals are probably represented in the present skull and I have indicated them at *x* in Plate LXI, Fig. 2. The exoccipitals are rather large and extended some distance under the base of the skull to unite anteriorly with the pterygoids, a very unusual arrangement. The pterygoids are elongate elements, *p*, with the usual relations, being bounded anteriorly by the vomer (prevomer of Broom) and laterally by the ectopterygoid. The vomer shows no evidence of being toothed although it may have been so in its anterior portions, which are partially obscured. The same may be said for the palatine which is indicated at *l*. The relations of the ectopterygoid are rather unusual for the Amphibia in the posterior extension of the element. It lies all along the side of the pterygoid and anteriorly projects forward between the pterygoid and the palatine. In this unusual posterior projection the ectopterygoid has almost obliterated the infratemporal foramen which possibly may be still represented by the triangular space between the bases of the pterygoid and the ectopterygoid. The anterior palatine foramen (internal nares) lies between the anterior ends of the palatine and the vomer, its usual relations in the Labyrinthodontia. The foramen may be recognized as the rounded depression slightly anterior to the palatine.

The mandible, *M*, is rather heavy and is coarsely sculptured with radiating grooves and ridges. The character of the teeth cannot be determined save to say that they were present. The posterior end of the mandible projects somewhat beyond the quadrate angle of the skull.

The interest in the present specimen is heightened by the light it throws on the characters for the separation of the Amphibia from the Reptilia. If we take as one of the chief characters of the Amphibia the wide separation of the pterygoids by the parasphenoid the present form, and undoubtedly all of the Microsauria, fall well within the Amphibia. Of course when we find forms showing other amphibian characters and with a reduced parasphenoid, then this character will no longer be of significance. One character which, thus far, seems to be restricted entirely to the Amphibia is the lateral line canals which are present on the skull as grooves and pits and on the bodies of some forms as specialized scales.

Measurements of the skull of *Erpetosaurus* sp.
(No. 8607 G, American Museum.)

	mm.
Length of skull in median line	45
Posterior width of skull (estimated)	50
Width of parasphenoid (estimated)	6
Width of pterygoid	5
Length of ectopterygoid	17
Width of mandible (posterior)	12

MACRERPETIDÆ, new family.

Plate LXI, Fig. 1.

It seems necessary to propose a new family for the reception of the single species *Macrerpeton* (*Tuditanus*) *huxleyi* (Cope). The characters exhibited by this species are so different from those offered by other members of the Carboniferous Microsauria that it is clearly distinct. In its cranial characters and the position of the orbits it approaches most nearly to *Eryops megacephalus* Cope from the Permian of Texas. In some of its characters the present form shows a similarity to *Dasyceps bucklandi* Lloyd, from the Permian of Kenilworth, England; more especially is this similarity found in the form of the skull, the size and shape of the teeth and the posterior position of the orbits and their wide removal from the border of the skull. Only a fragment of the skull is known but repeated study of this fragment has disclosed the wide diversity of its characters.

The new family may be defined as follows:—Skull larger than in any other known Carboniferous microsaurian; cranial elements sculptured with pits and coarse grooves; lachrymal element present; teeth large, curved outward and fluted; mandible heavy; orbits located far back on the skull and near the median line so that the interorbital space is about half the space from the outer edge of the orbit to the border of the skull, thus approaching the condition known in *Eryops*; the ribs (?) are strong and heavy with an incipient tubercle.

Sauropleura sp.

Plate LIX, Fig. 2.

The present specimen is figured here on account of a portion of the skin of the animal which is preserved as a smooth mold over the ribs and ventral scutellæ. The skin was undoubtedly that of the back since the creature is preserved on its belly and is interesting in not showing the slightest trace of scales or other hard plates. The ventral scutellæ are characteristic of the species of the genus *Sauropleura*. With one species of this genus, *Sauropleura scutellata* Newberry, the writer has found associated scutes of some size and the same fact was noted by Cope. The scutes are more fully described elsewhere and it will suffice here to say that they are quite large measuring in some cases more than 25 mm. in length by 12–14 mm. in diameter.

Eoserpeton tenuicorne (*Cope*).

Plate LXIII, Fig. 1.

Ceraterpeton tenuicorne Cope, Proc. Amer. Philos. Soc., XXII, p. 407.
Eoserpeton tenuicorne (Cope), Journal Geology, XVII, p. 76.

The type of the new genus already proposed for the species *Ceraterpeton tenuicorne* Cope is figured here for the first time. Its characters have already been given in the restoration of the entire skeleton.[1] The distinctive generic character is the wide expansion of the horned supratemporal element. The position of the orbits and the pineal foramen as well as the sutures separating the cranial elements can be readily determined from the photograph which is slightly larger than natural size. Further discussion will be reserved for the writer's forthcoming memoir.

Diceratosaurus robustus *Moodie.*

Plate LXIII, Fig. 2.

A photograph of the type of this species is given here for the first time. In the original description of the species [2] an outline drawing with a restoration of the skull was published. The characters are clearly apparent in the photograph. Especial attention is called to the distinct separation of the squamosal which in the type species of the genus Jaekel defined as being united into his "perisquamosal." [3]

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[1] Moodie, Roy L. Journ. Geol., XVII, No. 1, fig. 20.
[2] Moodie, Roy L. Journ. Geol., XVII, No. 1, fig. 15.
[3] Jaekel, O. Neues Jahrbuch für Mineralogie, Bd. 1, 1903, p. 116

Ptyonius mummifer *Cope.*

Plate LXIII, Fig. 3.

The present figure is given to indicate the close affinity between the true Microsauria and the Aistopoda as defined by Professor Cope. The present form was associated by him with the species *P. pectinatus* Cope which is utterly limbless. The limb bone shown at *a*, and the pectoral plates just below, either indicate the microsaurian origin of the Aistopoda or else indicate the generic separation of the present species from others placed in the Ptyoniidæ. The generic separation is doubtful on account of the characters of the vertebræ and it seems best to turn to the other alternative and say that some of the Aistopoda possess very diminutive limbs. The body in the present species is very long and slender and I have been unable so far to detect hind limbs. It was considered as possible that the elements figured at *a* (Plate LXIII, Fig. 3) might be a hyoid element but, save in *Cocytinus gyrinoides* Cope, hyoids are unknown among the Carboniferous Holospondyli, and on account of the presence of the large interclavicle the safest conclusion seemed to be to regard the element as a humerus. It is very small and slender and indicates a very weak limb which may possibly have had the appearance presented by the limbs of *Amphiuma.*

The *footprint* figured in Plate LXIV, Fig. 1, may pertain to some member of the Microsauria or a branchiosaurian but I suspect the former. It is preserved in hard shale from Phoenix Tunnel, Pennsylvania, and is represented in the figure three times the natural size. There are five toes and the first digit had an enlarged tubercle at the base. The other digits were short and stumpy and without claws.

The *plates* described by Professor Cope as *Tuditanus mordax,* and which he later located in the species *Diceratosaurus* (*Ceraterpeton*) *punctolineatus* Cope, is shown in Plate LXIV, Fig. 2. A comparison of the figure with the plates shown in Plate LXV will suffice to convince one that Cope's later reference was correct.

An idea of the size and proportions of the type of the genus *Tuditanus, T. brevirostris* Cope, may be had from an examination of Plate LXIV, Fig. 4. The skull is almost perfectly smooth.

Diceratosaurus punctolineatus (*Cope*).

Plate LXV.

Cope described the present form as pertaining to Huxley's genus *Ceraterpeton.* Jaekel has, however, clearly shown that the species does not

belong where Cope placed it and he erected the new genus *Diceratosaurus* for the species. He defines the genus thus: "Die wichtigsten Unterscheide gegenüber *Ceraterpeton* scheinen mir zu liegen in der vorgerückten Lage und geringen Grösse der Augenhöhlen, dem Zurücktreten der Quadratecken, der oberen Ausbreitung der Dornfortsätze." [1]

In his discussion of the type of the species Cope referred to a peculiar element which he could not determine, which resembled a lacertilian pubis. This is undoubtedly the peculiar scapula of the creature, as may be judged by reference to Woodward's figure of *Ceraterpeton galvani* Huxley.[2] The character of the scapula together with other characters combine to locate the genus *Diceratosaurus* in the family Urocordylidæ as defined by Lydekker.

I am totally unable to find anything in the type specimen which might correspond with the peculiar elements figured by Jaekel on Tafel V.[3] Nor has a study of other microsaurian pectoral girdles furnished any evidence on this point. I have never found more than the five elements in the pectoral girdle — two clavicles, two scapulæ and a single interclavicle. Other new points in regard to the species are the ventral scutellæ at *v* and the hand with the cartilaginous carpus at *h*, Plate LXV.

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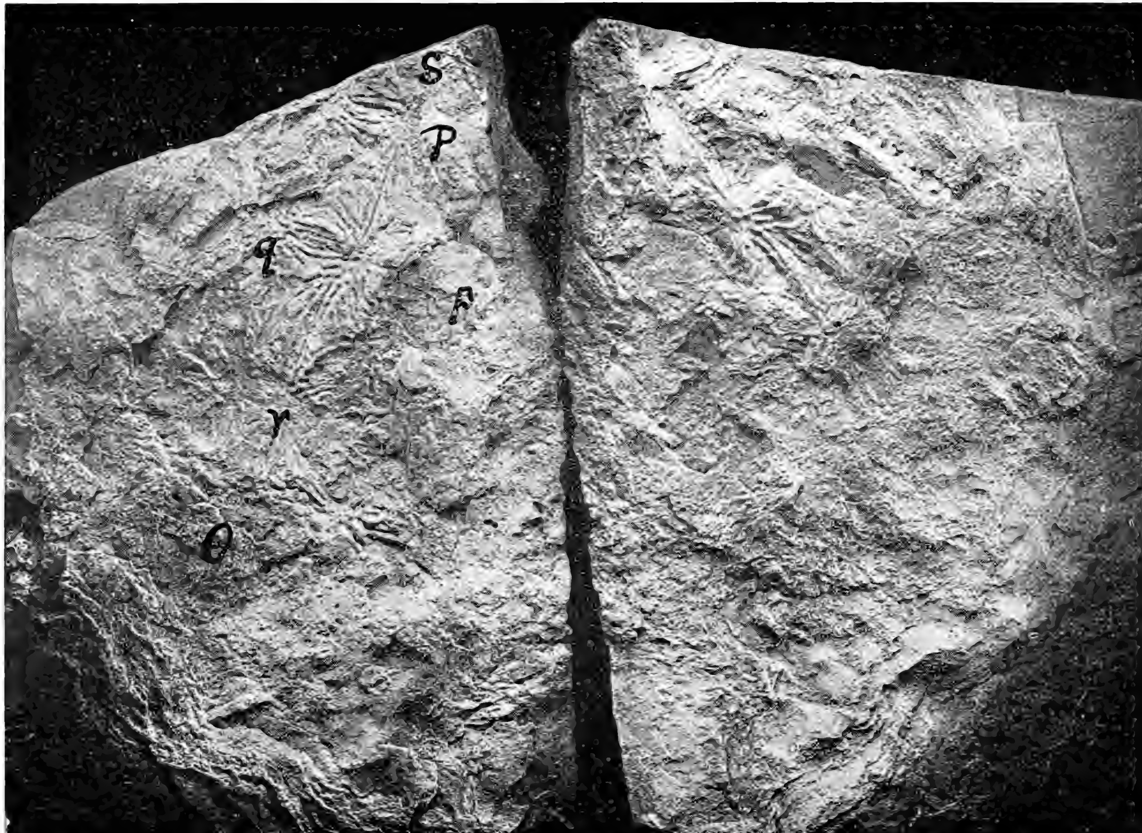
[1] Jaekel, O. Neues Jahrbuch für Mineralogie, Bd. I, 1903, p. 112.
[2] Geological Magazine, 1897, p. 293.
[3] Neues Jahrb. für Mineralogie, 1903.



Type, and its obverse, *Erpetosaurus tuberculatus* Moodie. × 1.25.
F = frontal; O = orbit; P = parietal; Q = squamosal; r = postfrontal; S = supraoccipital.

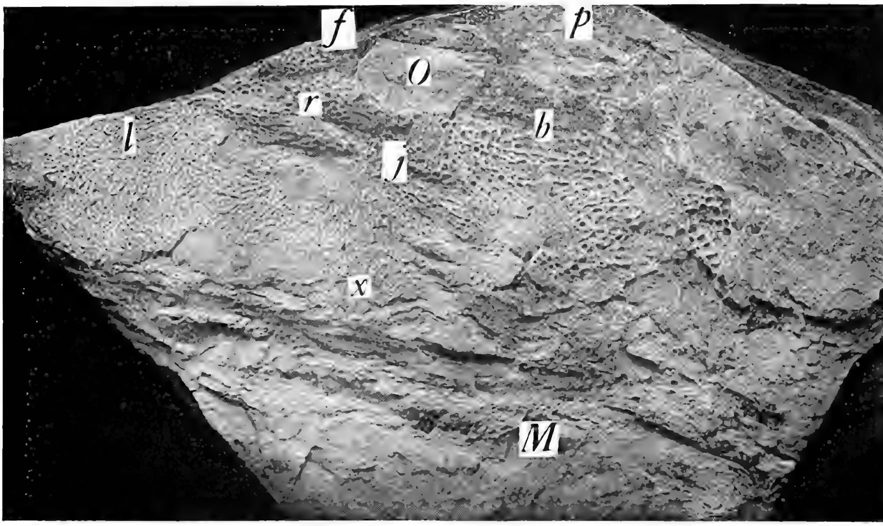


Fig. 1. Type of the genus and species *Macrerpeton huxleyi* (Cope) and the new family Macrerpetidæ. × .75. *M* = mandible; *O* = orbit; *b* = postorbital; *f* = frontal; *j* = jugal; *l* = lachrymal; *p* = parietal; *r* = prefrontal; *x* = maxilla.

Fig. 2. Mandible of *Erpetosaurus tabulatus* (Cope). × 3.33. *a* = angular; *c* = coronoid; *s* = surangular; *n* = angular; *d* = dentary.

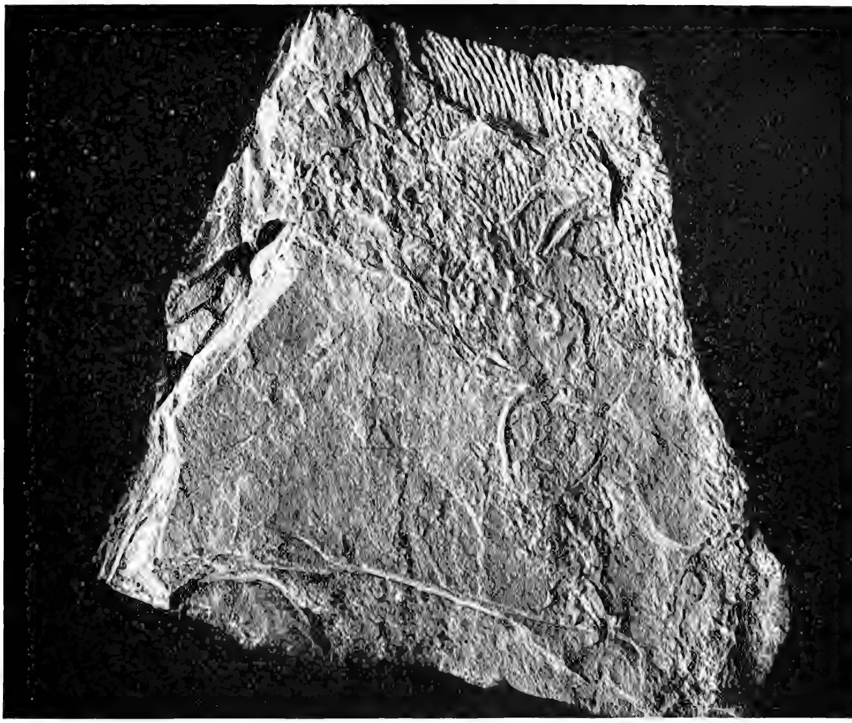


Fig. 1. Photograph of the block of coal on which is preserved the remains of the skin of *Sauropleura* sp. × 1.25.

Fig. 2. Type of *Erpetosaurus obtusus* (Cope). × 1.

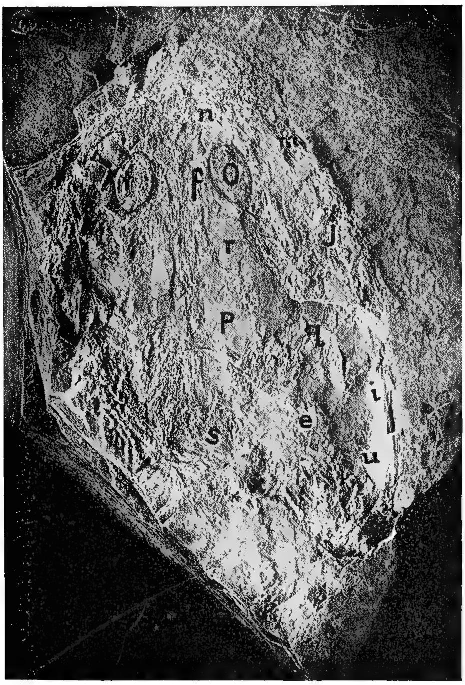


Fig. 1.

Fig. 2.

Fig. 1. Type of *Erpetosaurus acutirostris* Moodie. × 1.

Legend for the cranial elements as in Text Figure 1.

Fig. 2. Palate of *Erpetosaurus* sp. × 1.75.

a = vomer; *v* = prevomer; *p* = pterygoid; *t* = ectopterygoid; *l* = palatine; *m* = mandible.

Fig. 1. Type of the genus *Erpetosaurus* (*E. radiatus* (Cope). × 1.

Fig. 2. Type of *Erpetosaurus tabulatus* (Cope), on which is preserved the lateral line system illustrated in Text Figure 1. × 2.

Fig. 1. Type of *Eoserpeton tenuicorne* (Cope). × 2.33.

Fig. 2.

Fig. 3.

Fig. 2. Type of *Diceratosaurus robustus* Moodie. × 1. e = epiotic; f = frontal; N = nasal; O = orbit; P = parietal; Pf = post-frontal; S = supraoccipital; Sq = squamosal.

Fig. 3. Type of *Ptyonius nummifer* Cope. × 1. Limb bone at "a" (humerus).

Fig. 1.

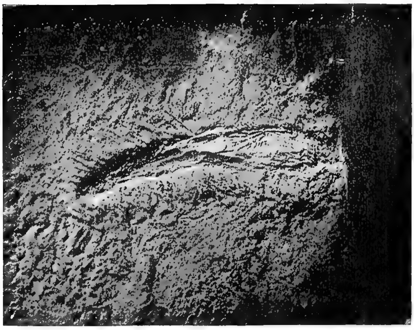


Fig. 3.

Fig. 1. Amphibian Footprint from Pennsylvania. × 3.
Fig. 3. Mandible of *Erpetosaurus tabulatus* (Cope). × 1.

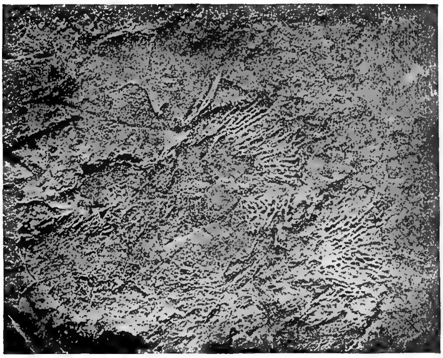
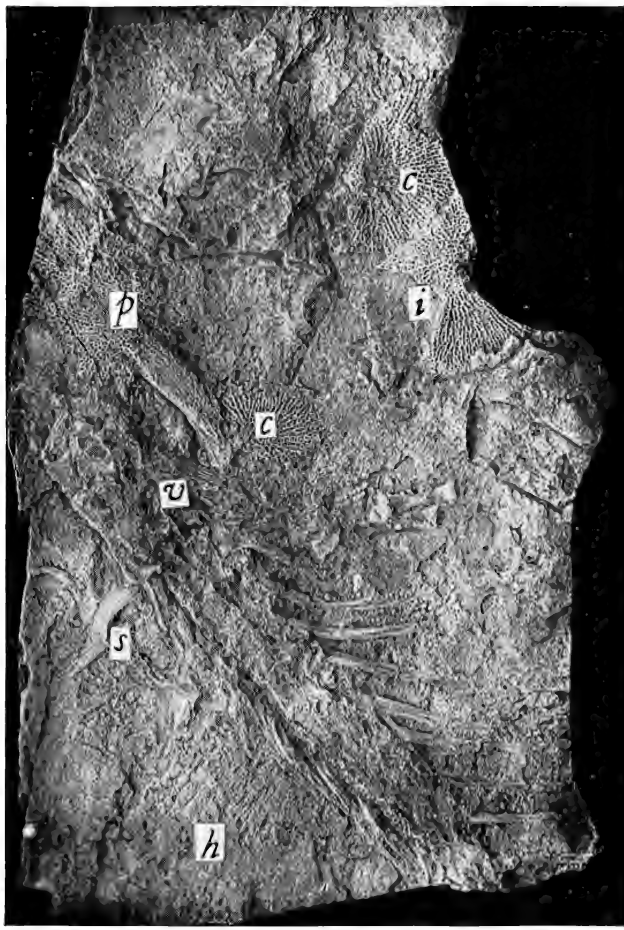


Fig. 2.

Fig. 4.

Fig. 2. Plates described by Cope as *Tuditanus mordax*. × 1.
Fig. 4. Type specimen of *Tuditanus brevirostris* Cope. × 1.33.



Type of Jaekel's genus *Diceratosaurus* (*D. punctolineatus* (Cope)). × 1.5.
c = clavicle; h = hand; i = interclavicle; p = supratemporal element of the skull; s = scapula; v = ventral scutellæ.

59.51,4H: 16.9: 51.7

Article XXVI.—HAPLOSYLLIS CEPHALATA AS AN ECTOPARASITE.

By Aaron L. Treadwell.

In 1900 Professor A. E. Verrill published a description of *Haplosyllis cephalata* from Bermuda, which agrees in most respects with two specimens collected for the American Museum at Andros, Bahama, by Dahlgren and Mueller in 1908. The only points of difference that I can find between them is that it is the rule rather than the exception that there are two aciculi and two bidentate setæ in each parapodium, and that the bidentate setæ often show two minute terminal teeth instead of a single tip. In these, also, the dorsal cirrus of the third somite is no longer than that of the second, though from here backward there is a noticeable decrease in length of these cirri. The posterior ends of both specimens were too badly preserved to admit of description.

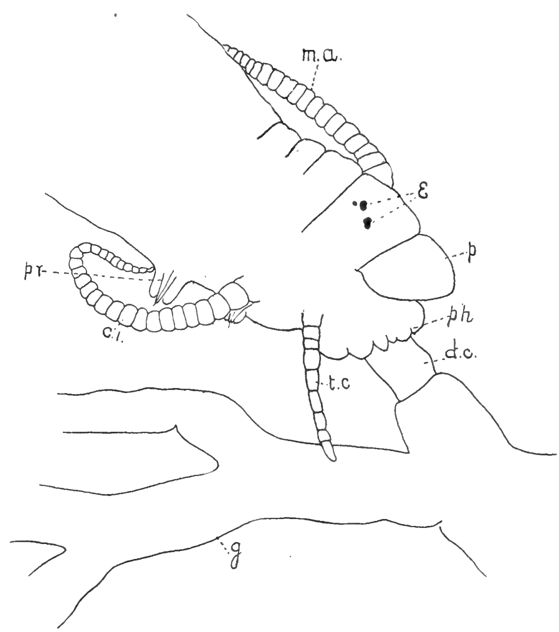


Fig. 1. Anterior end of *Haplosyllis* attached to cirrus of host. × 150. *m. a.*, median antenna; *e*, eye; *p*, palp; *ph*, pharynx; *d.c.*, dorsal cirrus; *t. c.*, tentacular cirrus; *c.i.*, cirrus of 1st somite; *pr*, parapodium; *g*, gill.

The especial interest in these individuals lies in the fact that both were firmly fastened, as external parasites, to the surface of the body of a large Eunicid. This latter was merely a fragment when it reached me, and identification was not possible. One *Haplosyllis* was attached to a ventral, the other to a dorsal, cirrus. In both cases the cirrus was surrounded by the pharynx and œsophagus of the parasite, though the one attached to the ventral cirrus broke away when I attempted to remove the parapodium. The

other retained its hold on the cirrus while the whole parapodium was removed from the body and stained for further study.

The relation of the anterior end of the parasite to the host is shown in Fig. 1. The figure is drawn on a scale which does not admit of representing the entire body of the *Haplosyllis*, but shows the head and anterior somites of the animal with a portion of the gills of the host. The dorsal cirrus is surrounded by the pharynx and œsophagus of the parasite, only about one quarter of the normal length of the cirrus being visible. An optical section of these parts is shown in outline in Fig. 2. Here it is seen that while the

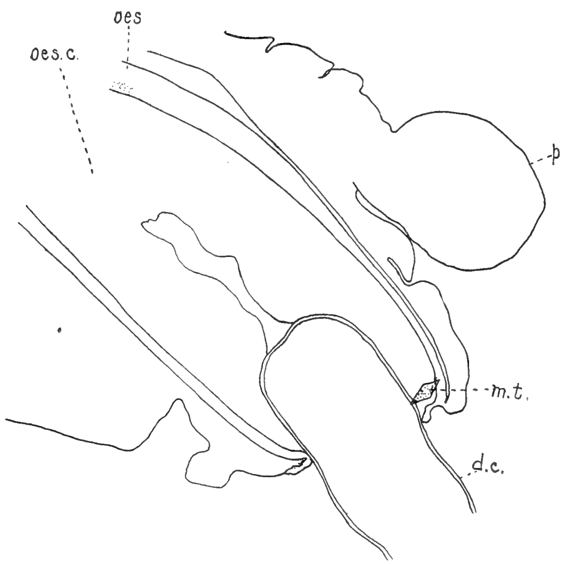


Fig. 2. Optical section of anterior end of *Haplosyllis*. × 250 *oes*, œsophagus wall; *oes.c.*, cavity of œsophagus; *m.t.*, median tooth. Other letters as in Fig. 1.

basal portion of the cirrus retains its form, the distal part has disintegrated and is apparently being digested in the œsophagus of the parasite. Fixation of parasite to host is partly accomplished by the single median tooth, which is imbedded in the wall of the cirrus.

The use of the term parasite in this connection may be criticised, as it may be said that the *Haplosyllis* is merely predatory and not truly parasitic. Inasmuch, however, as the attachment was close enough to survive the somewhat rough treatment incidental to preservation, staining and mounting, it seems to me that the attachment is sufficiently permanent to warrant the use of the term.

56.9 (1183: 78.2)

Article XXVII.—A PLIOCENE FAUNA FROM WESTERN NEBRASKA.

By W. D. Matthew and Harold J. Cook.

I. Introductory.

During the summer of 1908 the writers, in conjunction with Messrs. Albert Thomson, Roy L. Moodie and William Stein, were employed under direction of Professor Henry Fairfield Osborn in collecting fossil mammals in the Tertiary of Sioux Co., Nebraska, for the American Museum of Natural History. The expedition was in charge of Mr. Thomson and was provided for through the generosity of Mrs. Morris K. Jesup. We are indebted for many courtesies and material assistance in various ways, to Mr. James H. Cook of Agate, Neb., to whom our cordial acknowledgments are here made. The results of the season's work consisted of a large series of skulls and skeletons of Lower Miocene fossils, of a smaller collection from a Middle Miocene horizon, and of a large but mostly fragmentary collection representing a Lower Pliocene fauna hitherto unknown in the Plains region. The study and description of this part of the collection was assigned by Professor Osborn to the writers, and its results appear in the following pages.

The Pliocene mammals of North America are very imperfectly known. The various faunæ which have been referred to this epoch by Leidy, Marsh and Cope, are now regarded as chiefly Upper Miocene on the one hand or Lower Pleistocene on the other. The only true Pliocene fauna of the Western Plains, according to Osborn's recent correlation (U. S. G. S. Bull. No. 361), is the Blanco of Texas, referable to the Middle Pliocene and containing some twenty species of mammals.[1] The discovery of a large and varied fauna of Lower Pliocene age, intermediate between the Blanco and the typical Upper Miocene, and equivalent to the Pikermi fauna of Europe, helps materially to fill this gap in our series. The new fauna

[1] Certain beds containing *Elephas imperator* may also be referable to the Pliocene, but the two or three species which they are known to contain, can hardly be called a fauna.

represents over fifty species, mostly closely allied to those of the Upper Miocene, but differs (1) in the presence of more advanced species or mutations of the several phyla, and (2) of certain Pleistocene or modern genera not hitherto recorded from the Tertiary, (3) in the greater abundance and variety of three-toed horses, certain species of which show distinct approach to the Pleistocene *Equus* and *Hippidion*, and (4) in the abundance of gigantic camels of the genus *Pliauchenia*.

II. Stratigraphic Relations.

About the end of last June we made a prospecting trip to the Tertiary exposures south of the divide between the Platte and Niobrara Rivers, in Sioux Co., Neb.; and after a few days preliminary prospecting, the entire expedition was moved to this point and about three weeks spent in obtaining a collection. The exposures begin along the southern border of the sand-hill region which occupies the crest of the divide, and appear to be of independent origin from the deposits of the Niobrara valley. We regard them as laid down by a different river system and provisionally consider them as the northern margin of the Tertiary formations of the Platte River. Further exploration and more extensive collections will show what their time-relations to the Niobrara River deposits may be. The preliminary work indicates a much nearer relationship to the Tertiary beds to the southward. We may provisionally consider the sandhills of central Nebraska, east and west, as marking an old divide which separated the Tertiary deposition area now occupied by the Niobrara, White and Cheyenne rivers from the deposition area to the south, now occupied by the North and South Platte.

The exposures begin between the sandhills of the divide and the head-waters of Snake Creek, Sheep Creek and Spotted Tail Creek flowing into the Platte. Three distinct series of strata were identified at this point. The lowest, making up the main mass of the "breaks," is very barren, and no fossils were found in it except *Dæmonelix*. These beds may be provisionally considered as Lower Miocene, equivalent to the Dæmonelix Beds of the Niobrara valley. These have not been identified south of the Platte River. Overlying these, separated by an unconformity of erosion, are strata not represented in the upper part of the Niobrara valley, and containing a limited fauna of Middle Miocene age, characterized especially by *Merychippus*. These may be called the Sheep Creek beds, and appear to correspond in age to the Pawnee Creek beds of Colorado, the Deep River of Montana and the Mascall of Oregon. They consist of soft fine-grained sandy "clays" of a light buff color, free from pebbles, and containing harder calcareous layers. Their thickness is estimated at 100 feet. Near the top is a layer

of dark gray volcanic ash, two feet thick. *Merychippus* is the most abundant fossil, several incomplete skeletons were found by our party, besides numerous teeth and jaws. Two or more species of camels, one referable to *Alticamelus,* another to *Protolabis,* are represented by skulls, jaws and parts of skeletons. A large cervid, provisionally referred to *Palæomeryx,* and fragmentary remains of *Blastomeryx, Merycodus, ?Cynodesmus* and other carnivora and rodentia, were found; large and small tortoises are common.

Overlying the eroded surface of the Sheep Creek beds are the remains of a formation which we regard as an outlier of the Ogalalla, which covers the plains to the south of the Platte and extends southward and eastward into Kansas. The typical Ogalalla is composed of clean sand, with a considerable amount of gravel and pebbles of hard rock, scattered through its mass or collected in layers, and the whole mass cemented to a varying extent by lime. It is known to the Kansas geologists as the "mortar-beds." The older Miocene formations in the central Plains (Arickaree) are composed of a comparatively muddy sand, and lack the hard pebbles and gravel derived from the mountains. Even the coarse channel deposits in these older formations are usually composed mostly of mud-pebble conglomerates, not of crystalline or metamorphic rock pebbles.

The Snake Creek Beds, as we shall call this supposed local facies of the Ogalalla, lack this calcareous cement at the typical locality, but are otherwise very like the "mortar-beds" of the Republican River valley. They are composed of a clean sand, with gravel scattered through it, especially in certain layers, and mantling the eroded surface of the Sheep Creek beds. Locally the gravel is concentrated in what appear to have been heavy channel beds, and the sand has been in large part removed, probably by æolian erosion, leaving a residual mantle of some thickness wherever these channel deposits occurred. Scattered through the undisturbed sands of the formation are bones, jaws, etc., of a great variety of fossil mammals, and in the old channel beds are vast numbers of jaws, teeth, and water-worn fragments of bone, forming in places a bone-bed several feet thick. Complete skulls and associated skeletons appear to be very rare. The bones are hard and uncrushed, but for the most part more or less waterworn. Their state of preservation is very much as in the sands of the Niobrara River further to the eastward, and in the fossiliferous sand formations of the Pleistocene.

III. List of Species of Snake Creek Fauna.

Carnivora.

Canidæ.
- *Amphicyon amnicola* sp. nov.
- " sp. indet.
- *Ælurodon haydeni validus* mut. nov.
- " *sævus secundus* mut. nov.
- *Tephrocyon hippophagus* sp. nov.
- " cf. *temerarius* Leidy.
- " cf. *vafer* Leidy.
- " sp. maj.
- ?*Cyon* sp.

Procyonidæ.
- *Bassariscus antiquus* sp. nov.

Mustelidæ.
- 3 sp. gen. indet.

Felidæ.
- *Machærodont* gen. indet.
- ?*Felis* cf. *maxima* S. & O.

Rodentia.

Mylagaulidæ.
- *Mylagaulus* cf. *monodon* (Cope).

Castoridæ.
- *Dipoides brevis* sp. nov.
- *Dipoides tortus* Leidy.
- *Hystricops* cf. *venustus* Leidy.

Geomyidæ.
- *Geomys* cf. *bisulcatus* Marsh.

Edentata.

Megalonychidæ.
- Gen. indet.

Perissodactyla.

Rhinocerotidæ.
- *Teleoceras* sp.
- *Aphelops* sp.
- ?*Cænopus* sp.

Equidæ.
- *Hypohippus* cf. *affinis* Leidy.
- *Parahippus* cf. *cognatus* Leidy.
- *Merychippus* 2 or more sp.

Neohipparion 3 or more sp.
Protohippus 2 or more sp.
Pliohippus 3 or more sp.

ARTIODACTYLA.

Dicotylidæ.
Prosthennops cf. *crassigenis* Gidley.
" sp.

Oreodontidæ.
Merychyus (*Metereodon*) *relictus* subg. & sp. nov.
" " *profectus* sp. nov.

Camelidæ sp.
Pliauchenia (*Megatylopus*) *gigas* subg. & sp. nov.
Alticamelus procerus sp. nov.
" sp.
" sp.
Procamelus sp.
" sp.

Cervidæ.
Palæomeryx sp.
Cervus sp.
Blastomeryx elegans sp. nov.
Blastomeryx cf. *wellsi* Matthew.

Antilocapridæ.
Merycodus cf. *necatus* Leidy.
? " sp. maj.
? " sp. min.

Bovidæ.
Neotragocerus improvisus gen. et. sp. nov.
Bovid gen. indet.
Bison sp. indesc.

PROBOSCIDEA.

Elephantid, gen. indet.

Total,	Carnivora,	15 sp.
	Rodentia,	5 "
	Edentata,	1 "
	Proboscidea,	1 "
	Perissodactyla,	15 "
	Artiodactyla,	21 "
		58 species of mammalia.

IV. Correlation of the Fauna.

The above fauna is obviously closely allied to the typical "Loup Fork fauna" of Hayden, Leidy and Cope, and especially to the latest phase of that fauna, represented in the Republican River beds. The genera are with few exceptions Miocene, the species are in many cases indistinguishable from those of the Upper Miocene, while in others they show advanced mutations or are specifically distinct. Among the Carnivora, the aberrant dogs *Amphicyon* and *Ælurodon* are represented by more specialized forms than any hitherto known. The more typical dogs which we refer to *Tephrocyon,* include both large and small species nearly approaching the true *Canis* in teeth. The modern Central American genus *Bassariscus* is represented by a species nearly allied to one of the two living ones. The Felidæ are represented by both Machærodonts and true cats. The Rodentia include three, probably four, upper Miocene genera, all too imperfectly known for satisfactory correlation of species.

The Edentata form an important part of the Blanco and Pleistocene faunæ, and are unknown in the Miocene save for a single characteristic claw reported by Sinclair from the Mascall. A single claw, broken, but unmistakable, is the only representative of this order in the Snake Creek fauna. The presence or absence of edentates of distinctively South-American type in our northern faunæ is of the highest importance in correlation, as is the appearance of northern genera in the Pampean and other South American formations. The Mascall and Snake Creek edentate claws, while much larger than any Santa Cruz edentates, are decidedly small for Pampean genera.

The Rhinoceroses belong to the Upper Miocene and Pliocene genera *Teleoceras* and *Aphelops,* the one with very short limbs and long-crowned teeth, the other with longer limbs and shorter-crowned teeth. The material is too fragmentary for specific comparison. As in the Upper Miocene, a few survivors of the more primitive *Cænopus* group still persist.

Horses are by far the most abundant animals in the collection, and indicate a great number and diversity of species. The genera are the same as in the upper Miocene, but the more advanced forms, *Neohipparion* and *Pliohippus,* show a greater diversity of type, and some of the teeth show a marked approximation to the Pleistocene genera — in *Neohipparion* to *Equus,* in *Pliohippus* to *Hippidion.* This is true both in size and in the pattern of the crown, and suggests the direct derivation of the later genera from unknown or imperfectly known species of *Neohipparion* and *Pliohippus.* We do not mean by this to infer the American origin of the genus *Equus,* but to intimate that the structural origin of the *Equus* molar is more

probably through the *Neohipparion* molar with flat protocone, long straight crown, and moderate complication of the enamel lake borders than through the typical *Hipparion* molar with round protocone, shorter and more curved crown, and extreme complication of the lake borders. The habitat of the intermediate species may have been Holarctic or Asiatic, although it does not appear in the known Pliocene fauna of China. More complete material and more extended study is necessary to demonstrate the true relations of the Snake Creek horses to those of the Pleistocene. There is no conclusive evidence that any of them were monodactyl, nor is there among the thousands of teeth preserved a single one which we can refer to the genus *Equus*.

The Camelidæ are numerous and widely varied in size and proportions. The Miocene genera *Procamelus* and *Alticamelus* are well represented, and with them are gigantic Pliauchenias equalling those of the Blanco in size and robustness of limbs. The relative abundance of large camels, the general elongation of the molar crowns, and reduction of the premolars, and the extreme elongation of the limbs in the species of *Alticamelus*, indicate a later stage of evolution than among the later Miocene Camelidæ. The peccaries belong to the Upper Miocene genus *Prosthennops*, but some of the teeth approach quite closely to the primitive species of *Platygonus* recorded from the Blanco.

Oreodonts of the Upper Miocene genus *Merychyus* are present, though not common, but in most if not all of them the premolars are more complicated than in the Miocene species, and the caniniform p_1, is reduced in size, and functions as a premolar.

Among the Cervidæ and Antilocapridæ we find species identical with or equivalent to those of the Upper Miocene, with others, imperfectly represented, but apparently approximating the Pleistocene and modern genera.

The most unexpected feature in the fauna is the presence of Bovidæ. True antelopes are positively identifiable, and if our correlation of horns and teeth be correct, they belonged to the Tragocerine group, characteristic of the European Pliocene, and combining a primitive type of horns and teeth not found associated in any one section of the modern family. Remains of a species of *Bison* were also found, but there is some reason to doubt their pertinence to this fauna.

The Proboscidean remains are too fragmentary for exact identification. They are comparable to the so-called Mastodons of the Upper Miocene and Pliocene, *Gomphotherium* and *Dibelodon*, rather than to the true *Mastodon* of the Pleistocene. There is no indication of *Elephas*.

The nearest relationships of the above fauna are evidently with the "Upper Loup Fork" or Republican River Beds, regarded as Uppermost

Miocene or Lower Pliocene,[1] but the modernization is more apparent. The Archer (Alachua clays) of Florida and the Rattlesnake of Oregon may represent an equivalent stage, but are too little known for satisfactory correlation. The Blanco fauna, so far as known, is distinctly more modern, in the relative abundance of Edentata, in absence of Oreodonts, *Merycodus*, *Procamelus* and numerous other Miocene genera; but how far the absence of these genera may be due to our limited knowledge of the fauna it is impossible to say. Very little is known of the Blanco horses, which would furnish the most satisfactory comparisons, but Gidley has shown that the reported occurrence of *Equus* in this formation is an error, the species being all of the Protohippine group and not recognizably more advanced than the Miocene horses. The Snake Creek Pliauchenias compare with those of the Blanco in size and in reduction of the dentition, although of different species.

V. Descriptions of Genera and Species.

Amphicyon amnicola sp. nov.

Type, a lower jaw, No. 13846, with M_{1-2} and alveoli of the premolars and m_3. Size about equal to *A. giganteus* of the Middle Miocene of Europe, or *A. sinapius* of the Pawnee Creek beds of Colorado, but the reduction of the premolars is further advanced than in any known species of this group. The heel of m_2 is relatively narrow, and m_3 is large and two-rooted, as in *Amphicyon*. In *Dinocyon thenardi* and *Borophagus gidleyi*, the heel of m_2 is broad and m_3 short, one-rooted. This difference is probably generic, as it is correlated with the presence or absence of m^3 in the upper jaw, the primary distinction between *Amphicyon* and *Dinocyon* or *Borophagus*. The reduction of the premolars appears to be as in *Ursus*, a two-rooted p_4 with a diastema in front; but the jaw is broken off in advance of this diastema, so that we cannot determine the presence or absence of p_1. The form and proportions of the back of the jaw agree entirely with *A. giganteus*. The position of the condyle is considerably above the tooth-line, instead of below it as in *Ursus*, and the inferior margin of the jaw is much more convex beneath the molars than in that genus. The form of the coronoid process, so far as it is preserved, is much as in *Ursus*.

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[1] Osborn, *l. c.*

Fig. 1. *Amphicyon amnicola*, lower jaw, type specimen, external view × ½, and crown view of teeth natural size.

Measurements.

	mm.
P_4–m_3, length	105
M_1 anteroposterior	35.6
" transverse width of heel	18.8
M_2 anteroposterior	26.7
" transverse	19.5
Depth of jaw below m_3	67.
Height of condyle above angle	66.
Length from condyle to anterior alveolus of p_3	228.3

Several fragments of the skeleton indicate a carnivore of the largest size and are provisionally referable to this genus and species. The most distinctive is a scapholunar bone, measuring 63 mm. transverse by 54 mm. dorsoplantar, and 35 mm. proximo-distal.

? **Amphicyon** sp.

A smaller species of the Amphicyonine group is indicated by part of the lower jaw of a young individual, No. 13848, with p_4–m_1 perfect and unworn, and alveoli of p_3 and m_{2-3}. It is of the size of *A. ursinus* Cope but the second molar was much larger. The metaconid is comparatively small, the hypoconid high, crested and nearly median in position, the entoconid ridge low, marginal and divided by a furrow across its middle. No accessory cusps on p_4; the heel and anterior end are broadened but without cingula. The jaw is shallow, as would be expected in a young individual.

Measurements.

			mm.
P_4, anteroposterior	17.3;	transverse	8.5
M_1 "	30.2;	"	15.
M_2 alveolus, anteroposterior			22.5
Depth of jaw beneath m_2			36.

Ælurodon *Leidy.*

This genus is characteristic of the Upper Miocene. It has been reported by Douglass from the Flint Creek beds of Montana (Middle Miocene), but the specimen figured is too imperfect for positive identification. The genus differs from the remaining Canidæ in the presence of a strong antero-external cusp (parastyle) on the upper carnassial (as in Æluroidea); but in other respects the teeth are typically canid. The premolar region of the jaw is shortened, the premolars more or less reduced in size, massive and crowded. In the specimens from the Snake Creek horizon, this reduction and crowding

of the premolars is carried further than in any of the described forms, *Æ. sævus* Leidy being nearest in this respect. The genus *Hyænognathus* Merriam, from the Pleistocene of California, carries this specialization still further, but it is not certain that it can be derived from *Ælurodon*. In the Snake Creek species the lower teeth correspond in all details to *Ælurodon*, and three unassociated upper carnassials have the parastyle well developed.

Ælurodon haydeni validus mut. nov.

This mutation differs from the type of *Æ. haydeni* Leidy, in the shorter and more crowded premolar region, reduction of the tubercular teeth, and slight enlargement of the carnassial. It is based upon a lower jaw, No. 14147, with p_4–m_2 complete, and roots or alveoli of the other teeth. P_4 shows the characteristic form of *Ælurodon,* in its massive proportions, peculiar backward pitch of the protoconid, broad cingulate heel, and high

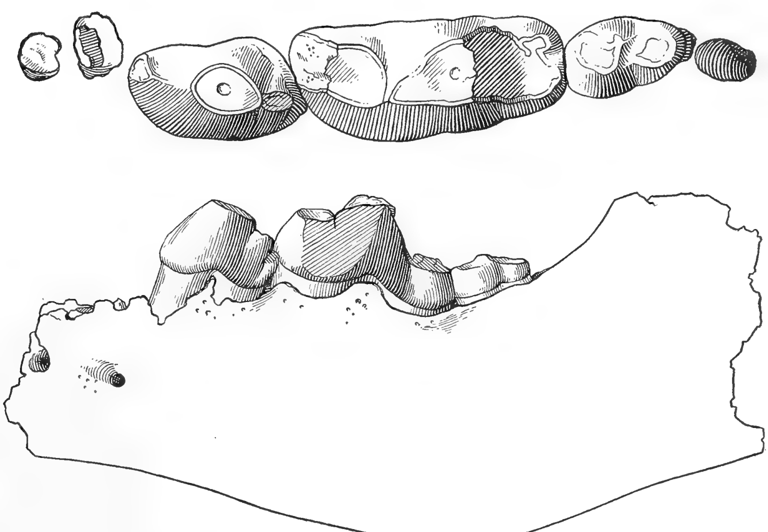


Fig. 2. *Ælurodon haydeni validus*, lower jaw, type specimen, external view × ⅔, and crown view of teeth natural size.

strong posterior accessory cusp. P_3 is much smaller, and set somewhat transversely in the jaw; in front of it is another transversely set tooth and the presence or absence of p_1 cannot be demonstrated. The canine alveolus indicates a large and massive tooth. M_1 is like that of the other Ælurodons, with massive paraconid and protoconid, small, low metaconid, and rather small bicuspid heel. It is longer but less robust than in *Hyænognathus*

pachyodon. M_2 is rather small, long-oval as in *Ælurodon,* not quadrate as in *Hyænognathus*; and there is a smaller oval alveolus for a single-rooted m_3. The jaw is massive, deep, and with strongly convex inferior border beneath the molars, as in other Ælurodons. In *Hyænognathus* the depth is less, the convexity of the inferior outline more posterior, the symphyseal region more massive, the anterior premolars shorter, not transverse, p_1 absent, and there is not metaconid on the carnassial.

Ælurodon sævus secundus, mut. nov.

Type, No. 13831, a lower jaw with p_3–m_2, and alveoli of the remaining teeth except the incisors. This jaw agrees in size with the type of *Æ. sævus* Leidy, but the premolars are more reduced and crowded, and the jaw shorter, than in the type or any of the referred specimens. The anterior

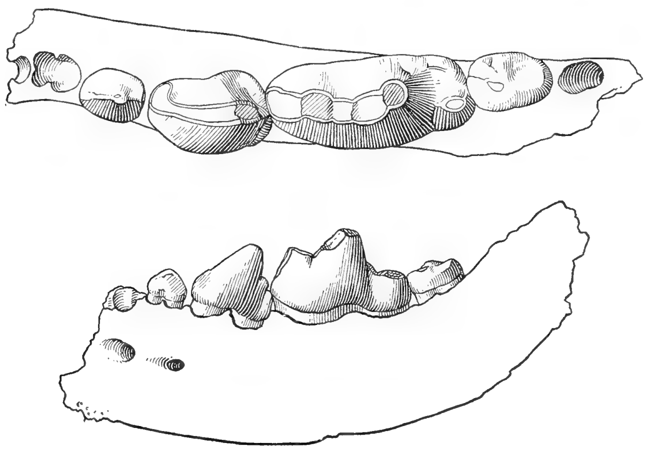


Fig. 3. *Ælurodon sævus secundus,* lower jaw, type specimens, external view × $\frac{2}{3}$, and crown view of teeth natural size.

premolars are shorter than in *Æ. haydeni validus,* and are not set transversely to the tooth line; the second molar is shorter and relatively smaller. It stands nearer in these respects to *Hyænognathus* than does the preceding form.

Ælurodon sp. div. indet.

A third jaw, No. 13832, a little larger than No. 13831, is doubtfully referable to *Æ. sævus.* The jaw is not so deep, the tubercular molars are more elongate, and m_3 is set in the base of the coronoid process, somewhat

as in *Æ. haydeni*. Three separate upper carnassials agree in size with *Æ. sævus* or the mutation above described, but are not regarded as determinable specifically.

Comparative Measurements (type specimens).

	Æ. sævus	*Æ. haydeni*	*Æ. wheelerianus*	*Æ. validus*	*Æ. secundus*	*H. pachyodon*
Lower dentition, p_3–m_3	69.7	97.	77.5	97.	67.	
P_4, anteroposterior diameter . . .		20.1	14.3	22.	15.8	
" transverse " . . .		10.		8.	10.	
M_1 anteroposterior " . . .	27.5	36.	28.	36.	27.	
" transverse " . . .	10.2	16.	11.	15.2	11.	
M_2, anteroposterior " . . .		18.	12.	15.	10.4	
" transverse			9.	10.	7.8	
Depth of jaw beneath p			25.		27.	
" " " " m_1	29.5	44.3	35.	48.	29.	
Thickness of jaw beneath m_1 . . .	14.8	20.	17.		12.8	

Tephrocyon hippophagus sp. nov.

This species is represented by eight lower jaws and part of an upper jaw, and probably by various skeletal parts. The type, No. 13836, is figured. The species is about as large as a coyote, but the jaw is much more robust and deeper anteriorly, and the teeth more massive. It approaches *Ælurodon* in these respects, and agrees with *Canis compressus* (Cope) and other Miocene species. More complete material will very probably show that these later Tertiary dogs are all generically distinct from *Canis*, and that many of them are referable to *Tephrocyon*.

In comparison with *Ælurodon,* the premolars are less reduced, more compressed and trenchant, the accessory cusps more prominent and compressed. P_4 does not have the peculiar backward pitch characteristic of *Ælurodon,* and probably correlated with the development of the parastyle on p^4. The species is considerably smaller than *Æ. sævus;* it is larger than *Canis* ("*Ælurodon*") *compressus* (Cope), the jaw longer and much deeper, the second and third molars smaller. The jaw is shorter and deeper than in any modern species of *Canis,* the dingo, *C. lupus* and the jackals coming nearest in this respect; the accessory cusps of the premolars are larger and the paraconid of m_2 is well developed. We are unable to make comparisons with the Pleistocene South American species which would probably show nearer affinities.

The species agrees quite closely in size and proportions with *Tephrocyon rurestris* Merriam of the Mascall beds of Oregon. The anterior basal cusps of the lower premolars are distinct, while in *T. rurestris* they are absent; the metaconid of the carnassial is smaller, the convexity of the lower border of the ramus is less, and other small differences appear to be indicated by Merriam's figures.

Nos. 13837–41, 13845 and 13850, add nothing to the characters of the type, but show a moderate degree of variability in depth of jaw, and slight differences in size and robustness of the teeth.

No. 13834, a fragment of upper jaw with m^{1-2}, is referred to this species,

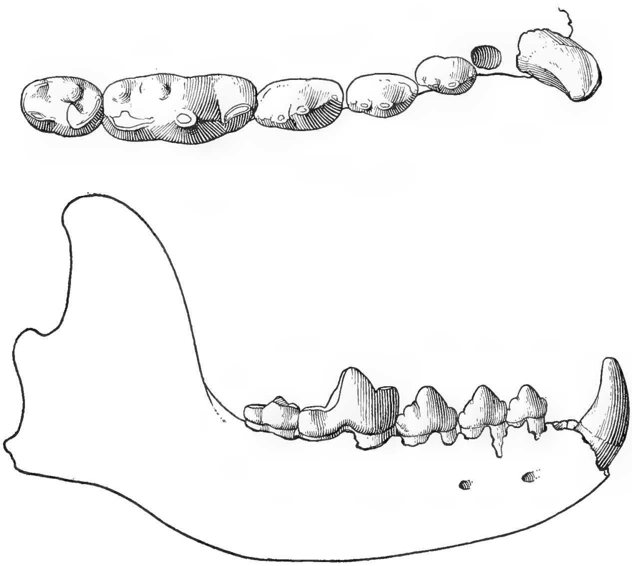


Fig. 4. *Tephrocyon hippophagus.* Lower jaw, type specimen, external view $\times \frac{2}{3}$, and crown view of teeth natural size.

from its agreement in size, and the resemblance of the teeth to those of *Tephrocyon* and *Ælurodon.* $M^{\underline{1}}$ agrees with these genera and differs from *Canis,* in the greater length of the anterointernal border, absence of paraconule and the more external position of the paracone. In the dentition of these genera the line of the external cusps of the upper molars makes more of an angle with the line of the sectorial blade, the molars being more asymmetric from the more external position of the anterior outer cusp (paracone). This in the Canidæ is a primitive feature retained to a varying extent from the ancestral Miacidæ. In the more predaceous Mustelidæ the angle becomes progressively emphasized with the progressive conversion of the

tubercular dentition into a transverse blade. Corresponding divergence in adaptation may be seen in the Æluroid group between the Viverrine and Feline extremes, also traceable back (structurally) to the Miacid type of dentition.

Measurements of T. hippopahgus.

				mm.
		Type, No. 13836.		
Lower jaw, canine to condyle inclusive				118.
Lower dentition c–m_3				79.
" premolars, p_{1-4}				33.
" true molars, m_{1-3}				35.8
P_2, anteroposterior		8.5;	transverse	5.
P_3	"	9.4	"	6.
P_4	"	12.	"	6.8
M_1	"	19.7	"	9.
M_2	"	10.3	"	7.2
Depth of jaw beneath m_2				25.2
" " " " p_2				21.3
Height from angle to tip of coronoid process				56.
		No. 13834		
Upper molars m^{1-2}, anteroposterior				21.
M^1, anteroposterior, along line of outer cusps				14.2
" transverse, across metacone				15.8
" oblique across paracone				18.
M_2 " " "		12.;	anteroposterior	8.

We are disposed to regard *Tephrocyon* as approximately ancestral to *Canis* on the one hand and *Ælurodon* on the other, and to refer to it a number of the later Tertiary dogs which have been heretofore placed in the modern genus *Canis.* They retain a number of primitive features, most of which are also retained by *Ælurodon,* but they differ from that genus in the absence or rudimentary development of the anteroexternal cusp or parastyle (protostyle of Scott's nomenclature) of the upper carnassial, in the less reduction of the premolars and in other more generalized features. The skull is known only in the type species, which, as Merriam observes, may be approximately ancestral to *Ælurodon.* The species from the Upper Miocene and Pliocene are somewhat nearer to *Canis,* but the direct ancestors of the modern species of wolves, jackals and true foxes will more probably be found in the Pliocene and Pleistocene of Northern Asia and Arctic America. Some of the smaller species of *Tephrocyon* from the later Tertiary of North America may however be direct ancestors of the modern dog-foxes of South and Central America.

? **Tephrocyon** sp.

A species closely resembling *T. hippophagus* but one half larger lineally

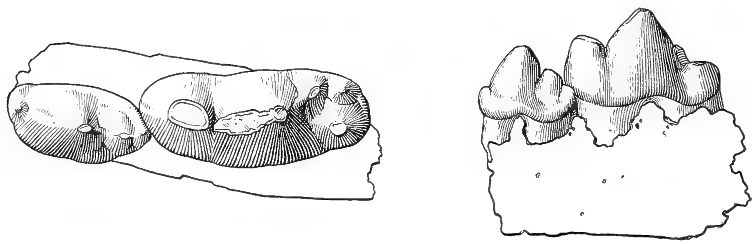


Fig. 5. *Tephrocyon* sp. indesc. Part of lower jaw, No. 13843, external view × $\frac{2}{3}$, and crown view of teeth natural size.

is indicated by a jaw fragment with p_4–m_1 and two isolated lower carnassials. It is intermediate in size between *Ælurodon haydeni* and *Æ. sævus*.

? **Tephrocyon** cf. **temerarius** *Leidy*.

No. 13859, a lower jaw with badly damaged teeth, agrees in size with Leidy's species. The jaw is shallower, the heel of the carnassial appears to have about the same construction and proportions; the remaining teeth are broken off in our specimen and absent in Leidy's type.

? **Tephrocyon** cf. **vafer** *Leidy*.

Another fragment of lower jaw, No. 13858, may be compared with this species although somewhat larger than the type, and with more elongate and slender premolar region of the jaw. The second molar is preserved entire with the roots of p_4–m_1. In the long slender premolar region it agrees better with specimens from Fort Niobrara referred by Cope to *Canis vafer*.

The slender jaw, rather large heel to the carnassial, compressed premolars etc., in this and the preceding species suggest relationship to the South and Central American "dog-foxes", in which the construction of the teeth approaches more nearly to that of *Tephrocyon* than it does in any of the northern Canidæ.

? **Cyon** sp.

We provisionally refer to this genus an isolated lower carnassial with trenchant heel and vestigial metaconid. It agrees in size with *Lycaon*

but in that genus the metaconid is better developed. A jaw fragment which may be provisionally correlated with the carnassial shows a rather long narrow m_2 and no third molar, but the crowns of the teeth are broken off and the association is hence uncertain. M_3 is retained in *Lycaon,* absent in *Cyon.*

In 1899 Wortman and Matthew painted out the relationship between *Temnocyon* of the upper Oligocene (and Lower Miocene) and the modern group of dogs represented by *Cyon,* with which should be associated *Lycaon* and *Icticyon.* This group differs from the typical dogs in the trenchant heeled carnassial and low trenchant tubercular teeth, and corresponding differences in the upper molars. The tubercular teeth are more or less reduced, the metaconid of m_1 small to absent, the premolars large, compressed with strong accessory cusps, skull rather short faced, and muzzle heavy.

Various remains of intermediate forms in the later Tertiary of North America have been found, all very fragmentary, but sufficient to give evidence of the validity of this relationship. Its especial interest lies in the fact that the three modern genera occupy marginal areas in the distribution of the Canidæ in South America, South Africa and India and their structural relationship is only explainable by a dispersal from a northern centre, preceding the dispersal of the typical modern Canidæ.

PROCYONIDÆ.

Bassariscus antiquus sp. nov.

An incomplete lower jaw, No. 13860, is not generically separable from *Bassariscus.* The specimen retains the molar teeth perfectly preserved, and the roots of p_4. It is about the size of *B. astuta*; m_1 has about the same proportions, but a higher paraconid; m_2 is one-fifth larger, the paraconid much better developed, the heel somewhat larger in proportion.

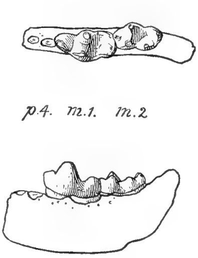


Fig. 6. *Bassariscus antiquus.* Part of lower jaw, type specimen, external and crown views, natural size.

Comparative Measurement.

	B. antiquus	*B. astuta*
Length p_4–m_2	17.4	17.2
M_1 anteroposterior	7.9	7.9
" transverse	3.8	3.9
M_2 anteroposterior	5.9	5.0
" transverse	3.5	3.2
Depth of jaw beneath m_1	7.	7.

The discovery of this species adds one more to the number of Central or

South American types in the late Tertiary faunæ of our Western States. The genus has not hitherto been found fossil.

Mustelidæ.

Three lower jaws are referable to this family but are hardly determinable as to genus. The two larger, Nos. 13861 and 13863 are apparently allied to *Potamotherium lacota* Matthew, although the second is considerably smaller. The generic reference of *P. lacota* is, however, wholly provisional, as the upper teeth and skull are unknown. The third jaw, No. 13862, is of much smaller size, probably mustelid, but has lost all the teeth. It differs from *Potamotherium* in the two-rooted m_2.

An upper carnassial, No. 13865, is possibly referable to "*Ælurodon*" *hyænoides*, which may prove to be a Mustelid, in spite of its large m^2 and the presence of a parastyle on $p^{\underline{4}}$.

Felidæ.

Part of an upper carnassial, part of a large laniary canine, and a claw, are the only indications of Machærodonts. A complete humerus compares

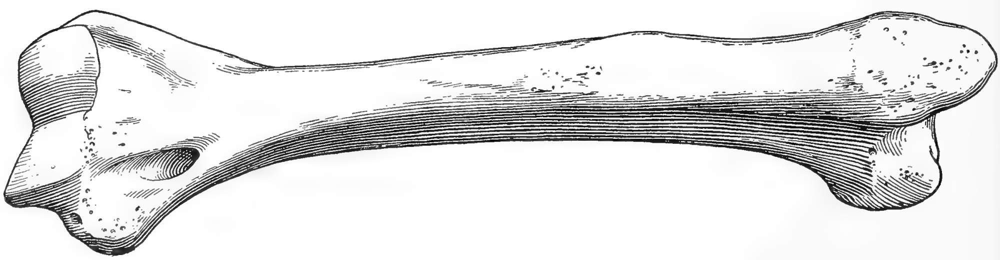


Fig. 7. *Felis* cf. *maximus*. Right humerus, anterior view, one third natural size.

much more closely with the true cats, and indicates a species one eighth larger than *F. leo*. Several astragali are referable to this family, and other skeleton bones, all indeterminate generically.

Humerus.	No. 13852	*F. leo*
Length	379.	339.
Width of head anteropost	108.	94.
Width of distal end, transverse	96.	83.5

Mylagaulidæ.

Three lower jaws and a separate premolar represent this family. These differ widely in size of premolar, pattern of its grinding surface and reduction of the posterior teeth. Nor do they agree closely in these respects with any of the described species. It is evident however from what we know of the Mylagaulidæ that there was either a very wide individual or age variation or an extraordinary number of species in proportion to the specimens known. The difference in wear of the four specimens under consideration is such that they might be regarded as representing four successive stages in the wear of the teeth of a single species, and referred to *Mylagaulus monodon* Cope. This view cannot be proven, except by sectioning the teeth and comparing their wear at different points, but is provisionally accepted in preference to making four distinct new species in addition to those already on record, which are almost as numerous as the specimens known.

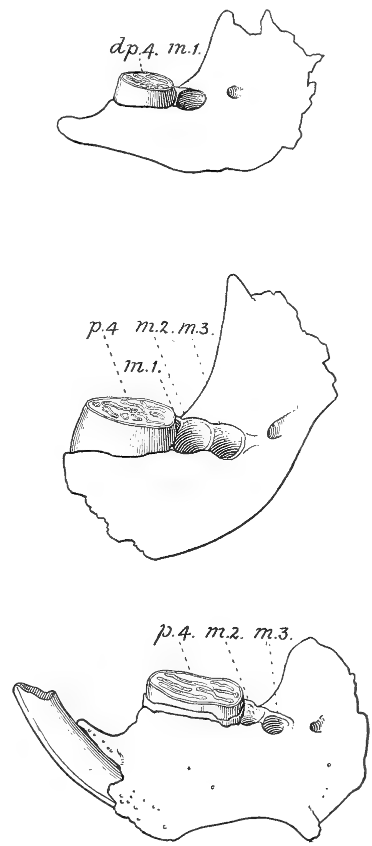


Fig. 8. *Mylagaulus* cf. *monodon* Cope. Lower jaws, natural size, internal views, illustrating three supposed stages in ontogeny of the teeth. Nos. 13867, 13868, 13866.

Mylagaulus monodon (*Cope*).

The type of this species is a lower jaw from the Republican River beds. Its generic relations to *M. sesquipedalis*, the type of the genus, are at present uncertain, and it may prove advisable to transfer it to *Epigaulus* Gidley.

Of the specimens referred here, the smallest, No. 13867, is considered as representing the milk dentition. The dp_4 is similar in form to its permanent successor but only three fifths as large, and with a simpler pattern, three as against four rows of enamel lakes in p^4 at a similar stage of wear. Behind the dp_4 is a single rather shallow alveolus for a small round m_1.

The second specimen, No. 13868, shows the permanent dentition at a similar stage of wear. The large p^4 has an oval wearing surface, which in the course of further wear will become considerably elongated, and finally much narrowed transversely. The pattern consists of four rather irregular enamel rows, somewhat oblique to the long axis of the tooth. Behind the premolar are two rather deep rounded alveoli for m_2 and m_3.

The type of the species shows a slightly more advanced wear of p_4, the rows of enamel lakes becoming more regular and less oblique and their number in course of being reduced from four to three.

In No. 13866 the wear of the teeth is considerably further advanced, the enamel lakes are more longitudinal and continuous, reduced to three rows, and the elongation of the tooth has encroached upon the alveolus of m_2 to a marked extent, both alveoli being quite shallow at this stage.

The remaining specimen, No. 13869, is a separate p_4, at nearly the same stage of wear as p_4 of the type of *M. monodon*, but is more elongate and narrow.

If the foregoing interpretation be correct, m_1 appears with the milk dentition, and is lost before the permanent dentition replaces it. This would accord with the conditions shown in the specimens of young Mylagaulid jaws figured by Douglass, although not with his interpretation of the specimens. It is very probable if this theory be correct, that *M. paniensis* Matthew represents the milk dentition of one of the larger species. The same may be true of *Mesogaulus ballensis* Riggs. The relations of the horned and hornless genera are not yet clear.

Castoridæ.

This family is represented by two Upper Miocene genera *Eucastor* (= *Dipoides*) and *Hystricops*, both being specialized descendants of *Steneofiber* of the Oligocene and Lower Miocene. *Dipoides* is distinguished by more hypsodont teeth of simpler pattern than in *Steneofiber* or *Castor*, *Hystricops* by the same characters in addition to larger size, greater relative enlargement and peculiarly inflated form of $p\frac{4}{4}$. Matthew in 1902 pointed out that *Hystricops* was more probably Castorid than Hystricid; if our reference of No. 13870, an upper jaw with p^4–m^1, to Leidy's species be correct, it is unquestionably quite nearly related in dentition to *Steneofiber* and *Dipoides*. These genera may represent the American derivatives of *Steneofiber*, but do not lead up into *Castor*,[1] which is more probably derived

[1] *Dipoides*, on the contrary, shows a marked approach, both in tooth pattern and in the characters of the infraorbital region, to the Pleistocene genus *Castoroides*.

from the Palæarctic Steneofibers through *Chalicomys* or unknown related forms of the Old World. *Dipoides* however, occurs in the Pliocene of China, and intermediates between it and *Steneofiber* are not known from our Miocene, so that it is perhaps also Palæarctic in origin. Intermediates between *Hystricops* and *Steneofiber* do occur in the Middle Miocene of Colorado, so that on present evidence this phylum appears to be of American origin; but they are very imperfectly known and this conclusion is provisional until the discovery of better specimens.

Dipoides tortus *Leidy.*

No. 13872, upper jaw with p^4–m^2, and 13873, five isolated molars and a humerus, may be referred to this species, but do not add to our knowledge of its characters.

Dipoides curtus sp. nov.

No. 13871, a lower jaw with incisor and p_4–m_2 perfect, represents a decidedly smaller species with relatively shorter diastema. The molars are less hypsodont and retain more of the *Steneofiber* pattern than in *D. tortus,* but otherwise it agrees with *Dipoides.*

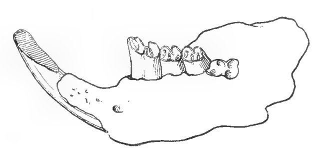


Fig. 9. *Dipoides curtus,* lower jaw, type, internal view, natural size.

Measurements.

	mm.
Length of lower dentition I_1–m_3	28.7
" diastema behind incisor	7.2
Diameters of I_1, anteroposterior 3.8; transverse	3.2
Diameters of P_4, anteroposterior 4.6; transverse	3.8
" M_1 " 2.8; "	3.1
" m_2 " 2.8; "	3.2
Depth of jaw beneath m_2	

Hystricops venustus *Leidy.*

The type of this species consisted of an associated lower premolar and molar. No. 13870, upper jaw with p^4–m^1 is referred on the ground of its correspondence in size, pattern, and the peculiar enlargement and inflated form of $p\frac{4}{4}$ in contrast with the more primitive type shown in *Steneofiber.* The size compares with the beaver and porcupine, but the tooth pattern departs widely from either. P^4 is a large robust tooth, rudely quadrant-shaped in cross-section, the anterior and internal surface strongly

convex, vertically as well as horizontally, the posterior and external surfaces flattened. The pattern of the grinding surface is like that of *Steneofiber* save that there are three small oval enamel lakes instead of one at the postero-external corner; antero-internal to these lies a deep enamel inflection from the external side, and antero-internal to this a deep inflection from the internal side; both inflections are converted into long narrow lakes in the course of wear.

The pattern of m^1 is the same except that there are only two small postero-external enamel lakes.

The teeth are rooted, although long-crowned, and the convexity and much greater length of the internal side of the crown indicates that it is pushed up from this side as it wears, and that the inner side therefore wears much more rapidly than the outer. The lower teeth are convex on the outer side and their wear comes principally on that side. The premolar is much longer crowned, and is also convex anteriorly, with corresponding results in the wear of its grinding surface. These conditions are seen in *Steneofiber* in a much more rudimentary stage; they are somewhat more advanced in *Dipoides*, and in *Hystricops* the specialization is carried still further.

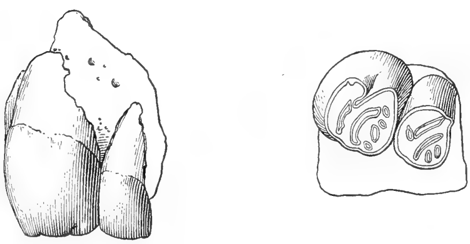


Fig. 10. *Hystricops* cf. *venustus*, upper teeth, natural size, internal and crown views, No. 13870.

The upper jaw shows a little of the root of the zygoma, which agrees in form and position with that of *Steneofiber*, and is unlike that of the Hystricomorpha. While there is not enough preserved to be of much weight as evidence of relationship, it accords with the tooth-pattern in referring the genus to the Castoridæ.

Measurements.

				mm.
Diameters of P^4 at grinding surface, anteropost.	9.5	;	transv.	8.8
" base of crown "	12.	;	"	14.
Diameters of M^1 at grinding surface "	7.	;	"	8.7
" base of crown "	6.	;	"	11.
Height of crown of P^4 internal	8.	;	external	14.
" M^1 "	4.	;	"	8.

Geomys cf. **bisulcatus** *Marsh.*

A lower jaw without molar teeth but otherwise nearly perfect is undoubt-

edly referable to *Geomys* and provisionally referred to Marsh's species, from the "Lower Pliocene" of Nebraska.

It is worthy of note that most if not all of our known Miocene and Pliocene rodents are fossorial. The skeleton of *Eucastor* is not known, but *Steneofiber, Entoptychus,* the Mylagaulidæ, *Thomomys, Geomys,* are all fossorial rodents, and *Hystricops,* as a descendant of *Steneofiber,* is presumably the same. It is of course to be expected that fossorial types would be relatively abundant in any fossil fauna, the conditions for their preservation being relatively favorable, but the entire absence of non-fossorial rodents, with the exception of the cursorial *Lepus,* is in contrast with the Eocene faunæ, where fossorial forms are few and arboreal forms abundant, and less sharply so with Oligocene faunæ where arboreal and terrestrial rodents are still numerous and the fossorial genera are not so highly specialized. The explanation is probably to be found in the climatic conditions. In a forested country with moist climate, the arboreal adaptations predominate, the terrestrial types are not specialized for running, and fossorial types are scarce. With progressively arid climate the forests are replaced by open plains, arboreal types disappear, most of the terrestrial types become specialized for swift running in open country and fossorial types become abundant.

Edentata.

A single imperfect claw, No. 14051, is all the evidence we have of the presence of this order in the Snake Creek fauna. It is definitely recognizable as of Gravigrade relationships, and compares with some of the smaller Megalonychidæ. In size it is intermediate between the Pampean and Santa Cruz genera. True Gravigrada have been supposed to make their first appearance in North America in the Middle Pliocene Blanco formation. But the discovery by Mr. Sinclair of an undoubted Gravigrade claw in the Mascall formation, Middle Miocene, shows that they were present in this continent at an earlier epoch. Except for this fact we would regard the presence of a gravigrade edentate as strong evidence for the Pliocene age of the Snake Creek beds.

Proboscidea.

Fragmentary Proboscidean remains are not rare in the Snake Creek, but we did not succeed in obtaining any very distinctive specimens. Part of a lower jaw, several incomplete teeth, two carpal bones, an astragalus, a patella, a cervical and a dorsal vertebra, indicate one or more large species

of the Mastodon group, apparently rather advanced in dentition as compared with most of the Miocene Mastodons which have been variously called *Gomphotherium, Trilophodon, Tetrabelodon, Tetralophodon* and *Dibelodon* (the first three names are based upon the same species and are undoubtedly synonymous, *Gomphotherium* having priority; the relations of the other two are not clear).

Rhinocerotidæ.

Various jaws, teeth, foot-bones, and other parts of the skeleton, indicate the presence of several genera of Rhinoceroses but most of the material is more or less indeterminate.

Teleoceras.

A complete ramus mandibuli, a nasal horn-core, and numerous characteristic foot-bones etc., are referable to this genus. The lower jaw appears to be specifically distinct from *T. fossiger*; the premolars are less reduced and the tusk exceptionally small. Some of the metapodials are even broader and shorter than in *T. fossiger*. Detailed comparisons with the Florida *Teleoceras* appear to be unprofitable.

Aphelops.

Various teeth and foot-bones are referable to the long-limbed rhinoceroses of the type of *A. malacorhinus* and *ceratorhinus*, in which the molars are more brachyodont, and premolars less reduced than in *Teleoceras*. This form also occurs in the Florida Pliocene, as well as in the Upper Miocene formations.

? Cænopus.

Teeth and foot-bones indicate also a much smaller and more primitive rhinoceros, which in the proportions and construction of the feet is widely different from *Aphelops* or *Teleoceras* and agrees with the rhinoceroses of the Lower Miocene, so far as comparison can be made.

Equidæ.

Remains of horses are very abundant and varied, but almost all fragmentary and waterworn. The best specimens obtained were two complete

lower jaws. There are some hundreds of incomplete jaws, and about ten thousand separate teeth, besides great numbers of limb and foot-bones, but none of them associated.

All but one of the genera of Miocene horses are here represented, viz: *Parahippus, Hypohippus, Merychippus, Protohippus, Neohipparion* and *Pliohippus.* The two first are comparatively rare; the four last (Protohippinæ) show a wider range of specific variation than in the Miocene. The abundant material for comparison indicates a very close relationship between the Protohippine genera, and it appears doubtful to us whether they should not all be regarded as at most subgenera of *Hipparion.* The distinction made by Gidley between *Merychippus* and the following genera lay in the short-crowned uncemented milk molars of this genus. A large series of young jaws of species very closely related to *M. insignis* throws some doubt upon the complete validity of this character, at least in the type species. The milk teeth, when preformed and first protruded above the bone, are cementless, but cement is deposited after their protrusion from the bone, so that by the time they come fully into wear they are quite heavily cemented. This appears to be also true, to a varying extent, of the milk teeth of the other genera. We do not exclude by this statement some differences in degree of cementation; but on present evidence they are not very great.

It is true that the Middle Miocene species referred by Mr. Gidley to *Merychippus* are more or less clearly distinguishable from most of those of the Upper Miocene by the comparatively short crowns of the permanent teeth, and absence of the higher specializations of one kind or another shown in those of the Upper Miocene and Pliocene; but we doubt whether the name *Merychippus* is properly applicable to them, as present evidence indicates that *M. insignis,* the type of the genus, known only from unworn milk teeth from an Upper Miocene or Pliocene horizon, is probably a more specialized form. It may prove advisable to revive Cope's name *Stylonus,* the only generic name applied to a Middle Miocene species, to cover this more primitive group of Protohippinæ, from the Middle Miocene beds. It is also to be observed that an adequate knowledge of the skulls and skeletons of the Lower Pliocene horses, would very probably show adequate generic distinctions among them. Our observations, confined mainly to the dentition, do not give clear and definite distinctions which we can regard as of full generic value. In view of these facts we do not think it advisable to attempt revision of the group until more complete material is at hand. Nor does it seem wise to attempt to define and name the various undescribed species indicated among our specimens of fossil horses.

Parahippus cf. **cognatus** *Leidy.*

This genus is rather rare in the Snake Creek fauna. It is readily distinguishable from the Protohippinæ by the brachyodont uncemented permanent dentition, from *Anchitherium* and *Hypohippus* by the crotchet of the upper cheek teeth and separation of metacone and metastyle in the lower series. Both milk and permanent teeth have a superficial resemblance to the unworn milk teeth of *Merychippus* and its allies. But a more careful examination shows the *Parahippus* pattern to be decidedly nearer to the lophodont type of the Anchitheriinæ while the pattern in the temporary dentition of *Merychippus* is more advanced toward the fully crescentic type of the Protohippinæ.

There does not appear to be more than one well defined species in the Snake Creek collection; it is close to or identical with *P. cognatus* Leidy.

Hypohippus sp.

Hypohippus is the least common of the fossil horses in our material. It is represented by an associated p^{2-3} a jaw fragment with two molars and several isolated teeth, and foot-bones. There is no evidence of more than one species, which agrees well enough in size with *H. affinis* Leidy. The metapodials are readily distinguishable by their more massive proportions, and certain differences in the proximal facets. The distal keels differ from those of *H. osborni* in the extension of the median keel on the dorsal side of the facet, a progressive character more marked in this species than most of the Protohippinæ, and fully as much as in *Equus*.

Merychippus.

To this genus we refer over half of the specimens in the collection. Typically they present in the permanent dentition rather short crowns, the protocone round-oval in section, partially separate from the anterior inner crescent, but not usually to the base, and to a varying extent in different teeth of the same individual, even if we make allowance for difference of wear. The borders of the lakes are moderately complicated. A large series of parts of jaws represents various stages of the milk and permanent dentition apparently of one species. The unworn milk teeth (Fig. 11) agree fairly well with the type of *M. insignis*; at a later stage of wear they are comparable with *M. mirabilis* (= *Protohippus mirabilis* auct. Gidley). A third stage (Fig. 11) shows the permanent premolars preformed beneath the milk molars, and other specimens (Fig. 11) show the permanent dentition in various stages of wear.

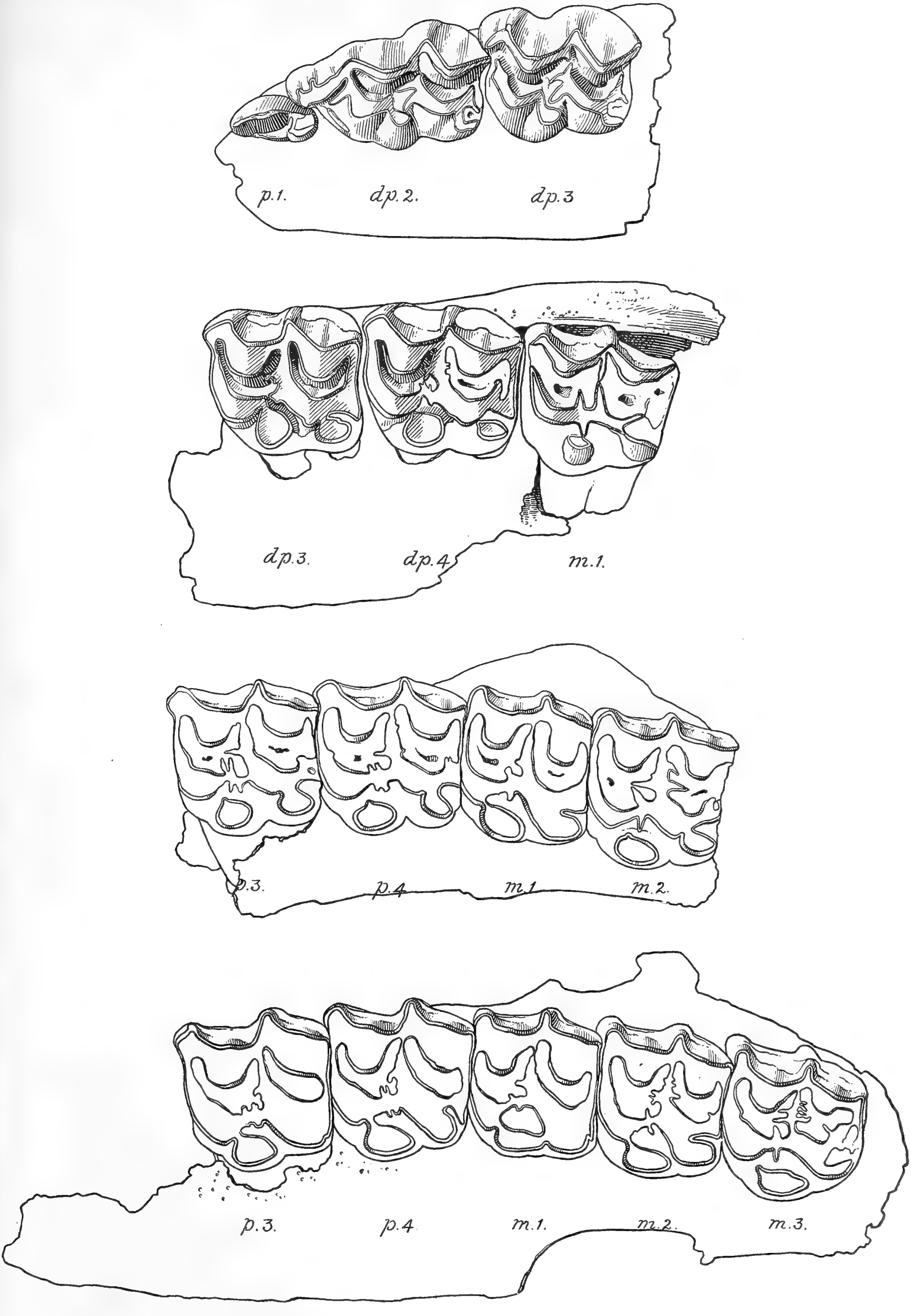


Fig. 11. *Merychippus* cf. *insignis*. Upper jaws of four individuals, illustrating the ontogeny of the teeth Nos. 14010, 14014, 14003, 14001; all natural size.

It is probable that several species are represented but their number and limitations are uncertain.

Neohipparion.

To this group we refer the teeth with relatively long crowns, little curved, with flattened protocone generally distinct to or nearly to the base, and enamel lake borders highly complicated. These vary greatly in size, the largest exceeding *N. whitneyi* and *occidentalis,* while the smallest are much smaller than any described Protohippinæ. A complete lower jaw shows the characters ascribed by Gidley to *Neohipparion* and agrees fairly well with *N. affinis* or *niobrarensis* in size and proportions.

Several metapodials agree in proportions with *N. whitneyi,* and are probably referable to this genus, in which some of the species had very long and slender limbs, the proportions being more deer-like than horse-like, as observed by Gidley.

Pliohippus.

We refer to *Pliohippus* the teeth with moderately long crowns, strongly curved, simple or nearly simple enamel lake borders, and protocone early united with protoselene and often with metacone as well. This group is rather well distinguished in the dentition and includes a very large species,

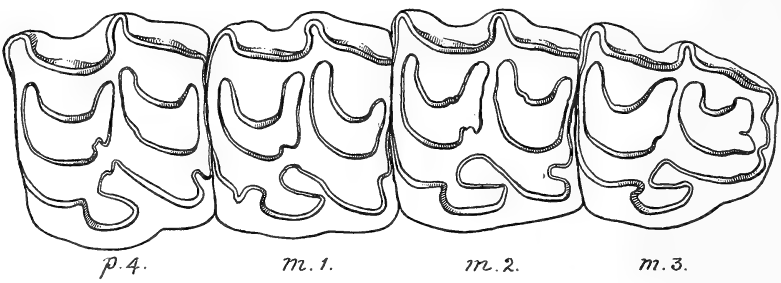


Fig. 12. *Pliohippus* sp. Upper teeth, natural size, No. 14004.

exceeding in size any described, and at least two smaller forms. The larger forms approach *Hippidium* in the dentition, but we have seen no evidence of the characteristic short monodactyl metapodials of this South American genus.

Protohippus.

Comparatively few of the teeth and jaw fragments agree very nearly with the typical *Protohippus* or with the smaller form represented by *P. placidus.* There are, however, a great many that might be included within the genus or subgenus more readily than with the three preceding.

Hipparion.

A considerable number of the teeth, etc., approach the American species which Gidley has referred to *Hipparion,* but do not seem to come especially near to the typical European species. In the absence of more satisfactory distinctions we do not feel warranted in predicating the presence of the true *Hipparion* in this fauna, unless we broaden the limits of the genus so as to include *Merychippus, Protohippus, Pliohippus* and *Neohipparion* as subgenera. As already intimated this inclusion does not appear to be justified without much more extended study than we have been able to give to the problem, especially in view of the careful and thorough consideration that Mr. Gidley has given to the relationships of these genera.

Foot-bones of Equidæ.

A large series of metacarpal and metatarsal bones show wide variations in size and proportions but for the most part have the relatively slender proportions of the known Protohippinæ. They separate into nine or ten quite well defined types of metacarpals and as many of metatarsals, indicating the presence of at least that number of species. But with the exception of *Hypohippus* and *Neohipparion,* it is impossible to positively correlate them at present with the teeth and jaws, and the provisional correlations that might be made would appear rather unprofitable labor. We have made no attempt at correlating the hundreds of astragali and other tarsal and carpal bones, phalanges, limb-bones and vertebræ.

Dicotylidæ.

Prosthennops cf. crassigenis *Gidley.*

A lower jaw, No. 14052, with p_3–m_3, indicates a species of *Prosthennops* about the size of *P. crassigenis.* Exact comparison is impossible, as the lower dentition of Mr. Gidley's species is not known, and the upper dentition

too much worn for accurate correlation. The species is distinguished from *P. serus* Cope, by smaller size, broader heeled m_3, and less molariform

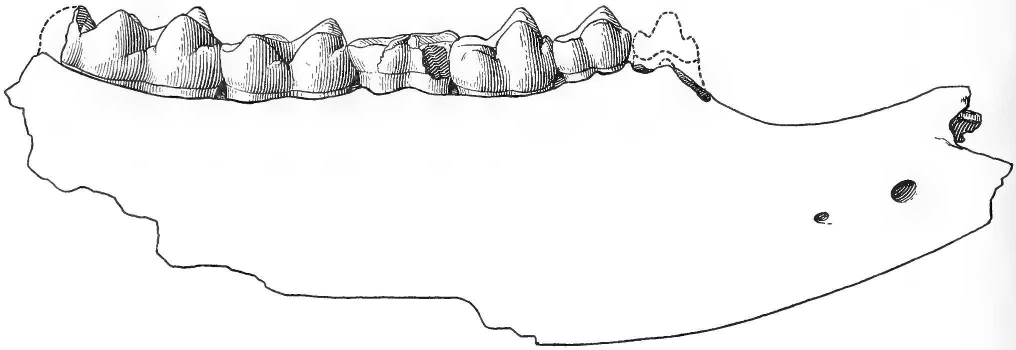


Fig. 13. *Prosthennops* cf. *crassigenis*. Lower jaw, natural size, external view, No. 14052.

premolars. The deuteroconid is distinct on p_3, but the heels are lower and less clearly bicuspid, the species thus approaching *Platygonus*.

Prosthennops sp. div.

A number of isolated teeth indicate at least two species of this genus, one as large as *P. serus*, the other smaller, agreeing in size with the lower jaw above described. They vary so much that they cannot be satisfactorily correlated.

The anterior molars and premolars of this genus of peccaries show a startling resemblance to the teeth of Anthropoidea, and might well be mistaken for them by anyone not familiar with the dentition of Miocene peccaries. We have not found among the dozen or so of teeth of this description, any which could not be placed in the dentition of *Prosthennops*. It should nevertheless be pointed out that the improbability of finding Anthropoid teeth in a Lower Pliocene formation in this country is substantially decreased by the discovery of true antelopes at this horizon. The Bovidæ have hitherto been supposed to first appear in North America in the Mid-Pleistocene, and man probably about the same time. The antelopes of the Snake Creek beds belong to the Tragocerine group which are found associated with extinct Anthropoidea in the Upper Miocene and Pliocene of Europe. Their occurrence at a corresponding horizon in this country was quite as little to be expected as the occurrence of anthropoidea would be, although of course not of equal scientific interest.

A metatarsal of a Dicotylid, presumably *Prosthennops*, is of some interest,

as hitherto nothing whatever has been known of the foot structure in any Tertiary Dicotylidæ. The foot referred by Osborn and Scott to "*Hyotherium americanum*" (= *Perchœrus*) is apparently that of an Oreodont, and no reasons are given for its reference to the Suoidea. The metatarsal from the Snake Creek bed indicates a completely didactyl pes, the lateral digit reduced to a short flat thin splint, but without coössification of the median pair, such as occurs in *Platygonus* and *Mylohyus*. In *Dicotyles* the lateral digits are less reduced.

Measurements.

				mm.
No. 14052.	Lower cheek teeth p_2–m_3 (m_3 estimates)			85.
	Lower true molars	"		53.
	P_3, anteroposterior	10;	transverse	8.
	P_4 "	12.5:	"	11.5
	M_1 "	14. ;	"	11.
	M_2 "	17. ;	"	14.
	M_3, transverse diameter			15.
No. 14053.	Metatarsal, length 102; diam. distal end			15.

OREODONTIDÆ.

Oreodonts are not common in the Snake Creek fauna, but include a variety of species related to *Merychyus*, but all of them more advanced in dentition than the type of that genus, *M. elegans* of the Upper Miocene Nebraska beds. We refer them to *Merychyus*, but as a separate section or subgenus.

Merychyus, sub. gen. **Metoreodon** sub. gen. nov.

Premolars more complicated than in the typical group. Lower canine premolariform, not enlarged.

The complication of the premolars consists in a series of minutiæ, the most obvious of which is perhaps the deep grooving of the outer side of the lower premolars, which is confined to p_4 in *Merychyus elegans*, but in *Metoreodon* has extended to p_3 and is more faintly indicated upon p_2 and even upon p_1. With this is associated a greater development of the inner crests of the premolars, the conversion of p_1 into a premolariform tooth no larger than the tooth behind it and similar in construction. The upper premolars show a correspondingly greater complication and the heel of m_3 is more clearly split into two crescents, with a corresponding development of a bifid heel upon m_3.

All these changes are the culmination of a slow evolution in the premolars

which is carried further in *Merychyus elegans* and other Upper Miocene species than in any of the Middle or Lower Miocene Oreodonts, and in *Metoreodon* is still further advanced. It appears probable that the changes proceeded independently in more than one subphylum of the family. But we have as yet no knowledge of the skull of any Upper Miocene or Pliocene Oreodont save the aberrant *Pronomotherium*, and cannot satisfactorily unravel the tangle of relationships and nomenclature until these later specializations of the family are more completely known. The reduction of the caniniform premolars appears sporadically as early as the Lower Miocene, in certain *Merychyi* from the upper Rosebud and Upper Harrison formations.

Merychyus (Metoreodon) relictus sp. nov.

Type a lower jaw, No. 14056, with almost unworn teeth, the canine, incisors and second molar missing. This species is about the size of *Merychyus elegans.* The alveoli of i_{1-3} and c_1 indicate teeth of about the same

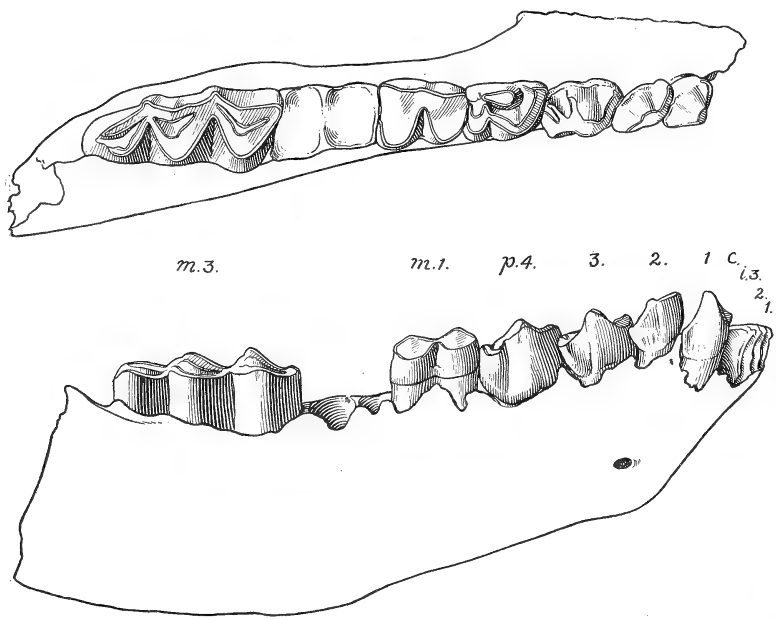


Fig. 14. *Merychyus relictus*, lower jaw, type specimen, external and crown views, natural size.

size. P_1 is much smaller and its crown premolariform with compressed pointed crest recurved inward at the anterior end, smaller than p_2, set obliquely in the jaw. P_2 is much larger than in *M. elegans*, with rudimentary

inner crests, outer border as in p_1 but less pointed. P_3 is very similar to p_4 of *M. elegans*, except that the posterior inner crest is replaced by three small transverse crests projecting inward from the outer crest. These are rudimentary in *M. elegans*. The outer face of the outer crest is deeply grooved behind the apex, about as in p_4 of *M. elegans*. P_4 has the outer groove more accentuated than in *M. elegans*, and the posterointernal crest is more distinct from the outer crest. The molars are about as hypsodont as in *M. elegans*; the heel of m_3 is composed of two distinct crescents, which are not united by wear until after the union of the crescents in front of them.

Measurements of M. relictus, type.

			mm.
Lower dentition, length			86.
" true molars, length			47.
P_1, (oblique) length	8. ;	width	5.
P_2 " "	9.2;	"	5.8
P_3 " "	10.8;	"	7.5
P_4 " "	12.8;	"	8.
M_1 (anteroposterior) length	11.3;	(transverse) width	9.
M_3 " "	24. ;	" "	11.
Depth of jaw beneath p_3			23.
" m_3			28.

Measurements of larger forms (infra).

				mm.
No. 14058;	length of m_{1-3}			55.
"	P_4, length	15; width		9.
"	Depth of jaw beneath p_3 (internal side)			30.
"	" m_3 (external)			33.
No. 14065;	length p^1–m^3			90.
"	" m_{1-3}			49.5
"	diameters of m^3, anteroposterior 24; transverse			18.
No. 14057;	length of m_{1-3}	55. ; of p_3–m_3		82.
"	P_4, length	15.4; width		10.
"	Depth of jaw beneath p_3, 34; beneath m_3			39.5

Merychyus cf. **relictus.**

A large variety or distinct species is indicated by several lower jaws or parts of jaws, Nos. 14060, 14058 and 14064. Two upper jaws, Nos. 14065, 14067, may be correlated with these. There is no gap between c^1 and p^1, and the two anterior premolars are relatively larger than in *M. elegans*, but all the premolars are worn or broken. The molars are very similar to those of Leidy's species. This form is a little larger throughout than his type, intermediate in size between *M. elegans* and *M. medius*.

Merychyus sp.

A lower jaw, No. 14057, about the size of the preceding but the premolars more compressed and less complicated, p_1 enlarged as in *M. elegans,* but heel of m_3 more bifid. The jaw is deeper and shorter than in the preceding forms or *M. elegans.*

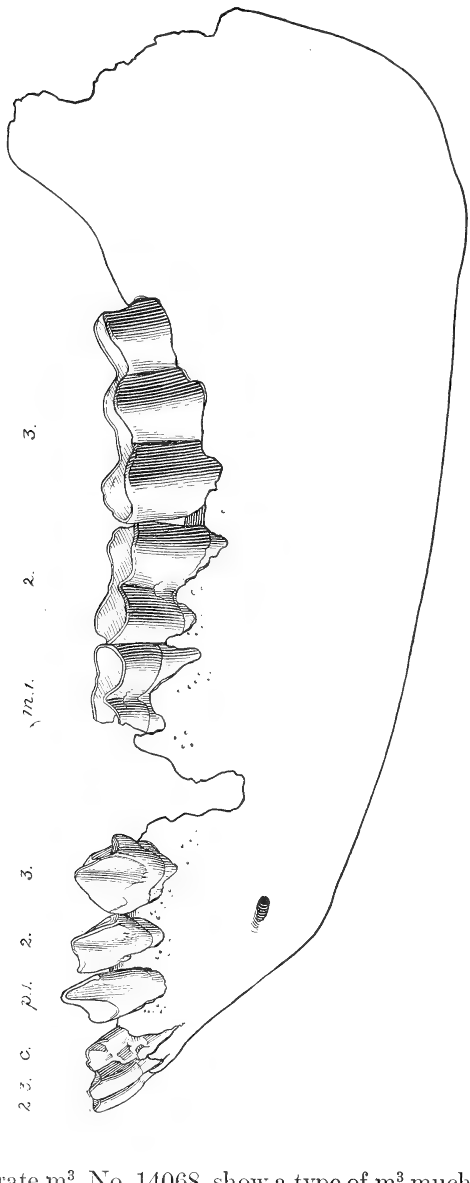


Fig. 15. *Merychyus profectus,* lower jaw, type specimen, external view, two thirds natural size.

Merychyus (Metoreodon) profectus sp. nov.

Type No. 14055, left ramus of the lower jaw with dentition complete except i_1 and p_4. This species is about the size of *M. medius* Leidy, but m_{1-2} are considerably larger and the heel of m_3 is not bent outwards as in that species, but aligned with the inner border of the tooth-row. The anterior teeth increase uniformly in size from i_2 to p_3, and form a progressive series in their structure, which is almost identical with that of *M. relictus,* allowing for some difference in wear. The inner and outer crescents are still partially separate on the heel of m_3, united on all the anterior crescent pairs.

Various fragments of jaws and teeth are referable to this species. An upper jaw, No. 14066, which appears to be of appropriate size and a separate m^3, No. 14068, show a type of m^3 much like that of *Merychyus elegans* but

with the bifid posterior outer end much more developed. A tooth of this type was figured by Leidy in 1869[1] and referred doubtfully to *Merycochœrus*, but it is wholly different from the m^3 of that genus, and is evidently much nearer to *Merychyus*, and especially to the present species. It was recorded as from the same locality as *Merycochœrus proprius* but may be from a later horizon.

Measurements of M. profectus, type.

			mm.
Lower dentition, length, i_2–m_3			155.
" true molars $m_{\overline{1-3}}$			82.
P_1, oblique length	12.	; width	8.
P_2 "	15.5;	"	8.5
P_3 "	17.4;	"	12.
M_1 anteroposterior est	18.	; transverse	15.
M_2 "	23.	; "	17.
M_3 "	41.	; "	18.5
Depth of jaw beneath p_3			38.
m_3			46.

Camelidæ.

The Camels of the Snake Creek beds are next in abundance to the horses and much more varied in size. They include three diverse types comparable to *Pliauchenia, Alticamelus* and *Procamelus,* as these genera are generally understood, with a variety of apparently intermediate forms. The intergradation may however be due to the lack of associated material. Our material includes a fragmentary but uncrushed skull of *Pliauchenia,* a badly crushed skull and jaws of *Alticamelus,* associated with considerable parts of the skeleton, and a great number and variety of parts of jaws, teeth, and isolated limb and foot bones, vertebræ, etc., representing apparently some eight or ten species of camels.

The Miocene Camelidæ are sadly in need of revision, and the senior author of this paper has undertaken this task. It is not advisable in this paper to discuss the nomenclature or generic references of the species described, nor to give names to the several undescribed forms indicated by fragmentary material.

Pliauchenia *Cope.*

The type of this genus is *P. humphreysiana,* founded upon a fragment of lower jaw from the Miocene of New Mexico, in which p_2 is stated by Cope to be absent. There is however a distinct alveolus, in the type specimen, indicating the presence of p_2, although the tooth may have been vestigial or

[1] Extinct Mam. Dak. and Neb. Pl. X, fig. 5.

abnormal. There are nevertheless various jaws of medium-sized or small camels from the Upper Miocene in which p_2 is normally absent. It is not at all certain that they pertain to one genus, nor that they are congeneric with the type of *Pliauchenia*. But in the absence of additional material from the type locality of *P. humphreysiana* we cannot satisfactorily revise the identifications.

In 1892 Cope referred to the genus a gigantic species from the Blanco Pliocene, *P. spatula*, based upon a complete lower jaw, in which p_2 is certainly absent. An incomplete skull in the American Museum collection from the Blanco, agrees fairly well with this species in size and proportions, and indicates the absence of the second premolar in the upper as well as in the lower jaw.

Various remains of large camels in the Snake Creek beds agree generically with *P. spatula*. It is doubtful whether they are congeneric with the little Pliauchenias of the Miocene with p_2 present (vestigial) or absent, but at present we have no satisfactory generic distinctions except the wide difference in size, the more advanced reduction of the premolars, and somewhat longer crowned molars. It is convenient to regard these as subgeneric.

Megatylopus subgen. nov.

Gigantic camels with dentition $I\frac{1}{3}\ C\frac{1}{1}\ P\frac{3-2}{3-2}\ M\frac{3}{3}$, the second premolar absent in both jaws, the first retarded or absent, the reduction of the posterior premolars intermediate between *Procamelus* and *Camelus*. Upper molars with prominent external ribs and styles, as in *Auchenia* Limbs and feet moderately elongate and very massive, large in proportion to size of skull. Type *M. gigas* infra.

Pliauchenia (Megatylopus) gigas sp. nov.

Type a skull, No. 14071, from the Snake Creek beds of Nebraska, found by Albert Thomson. We refer to the species various jaw-fragments, teeth, limb- and foot-bones from the same locality, on account of their appropriate size and their generic agreement with *P.* (*M.*) *spatula* from the Blanco beds of Texas.

The skull lacks the premaxillæ, and the posterior part was weathered into fragments, but it is practically uncrushed, and by diligent piecing, it was possible to restore the entire cranial part from the fragments preserved.

The skull is about the same size as in the Bactrian Camel, although the limb bones indicate a much larger animal. The form differs materially from *Camelus*; the muzzle is very much fuller in advance of the orbits and considerably deeper. The orbits are less prominent, the cranium deeper

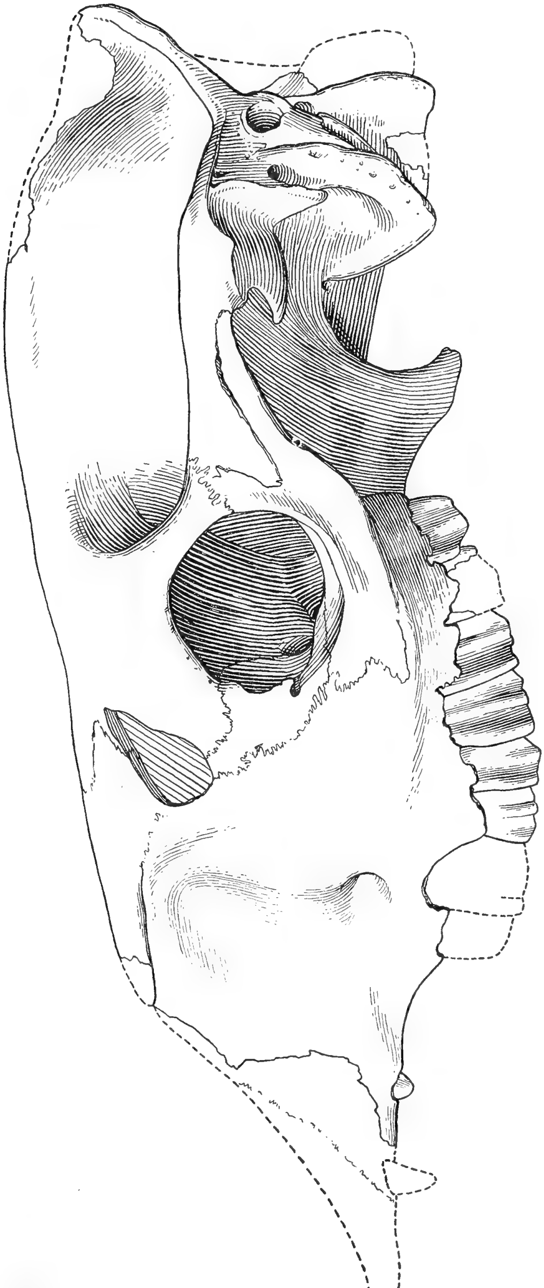


Fig. 16. *Pliauchenia gigas*, skull, type specimen, one third natural size.

and more capacious, the angle between basifacial and basicranial axes is considerable, while in *Camelus* they are nearly parallel. In all these respects the skull shows much closer relationships with the llama, The lachrymal vacuity is very large and sub-round, the orbit is large, rather low down on the side of the face, and situated above $m^{\underline{3}}$ as in *Camelus,* while in *Auchenia* as in *Procamelus* it is further back. There is a shallow maxillary fossa situated above the infraorbital foramen and in front of the lachrymal vacuity. The cranial portion of the skull is relatively long in comparison with *Camelus, Auchenia* or even *Procamelus.* The glenoid articulations are set wide apart, the process external to the fossa is absent, and in the entire conformation of this part of the skull *P. gigas* agrees with *Auchenia* and *Procamelus* more nearly than with *Camelus.* The postglenoid process is better developed than *Auchenia* and *Procamelus,* but agrees with them in form. The zygomatic process of the squamosal extends forward to a point almost beneath the posterior margin of the orbit, as in *Procamelus* and *Auchenia,* but is much heavier anteriorly than in these genera or in *Camelus,* in which it does not extend so far forward. The jugal is deep beneath the orbit, its inferior margin is a strong compressed crest, entirely absent in *Auchenia* or *Camelus,* incomplete and less prominent in *Procamelus.*

Dentition.— The canine alveolus indicates a large tooth. The first premolar is a good sized tooth, with pointed-spatulate crown, but appears to be retarded in development, as it is just breaking through the jaw while the permanent p^{3-4} and m^3 are already in use. In *Auchenia* the two caniniform teeth are at this stage in eruption while the milk dentition is still present and m^3 is preformed but has not begun to erupt. The diastema behind $p^{\underline{1}}$ is rather short, and a much shorter diastema intervenes between $p^{\underline{1}}$ and the canine alveolus. This, with the general proportions of the face, indicates a much shorter muzzle than in *P. spatula.*

The cheek teeth are considerably larger than in *Camelus bactrianus.* The premolars are less reduced, their internal crescents more incomplete. The molars are less hypsodont than in *Camelus,* and, as in *Auchenia,* the parastyle, mesostyle and external ribs are very prominent. In *Procamelus* and *Camelus* they are much less prominent. A rudimentary internal pillar between the internal crescents is present, as in *Auchenia,* but there is no trace of the small protostyle of that genus (internal to the protocone).

Lower dentition.— Three fragments of lower jaws of appropriate size for this species show the absence of $p_{\overline{2}}$, but p_{3-4} less reduced than in the Blanco species.

Skeleton.— We are unable to positively associate any skeleton material with this skull, but an ulno-radius of very large size found on the opposite side of the little draw from which the skull was taken, may belong to the

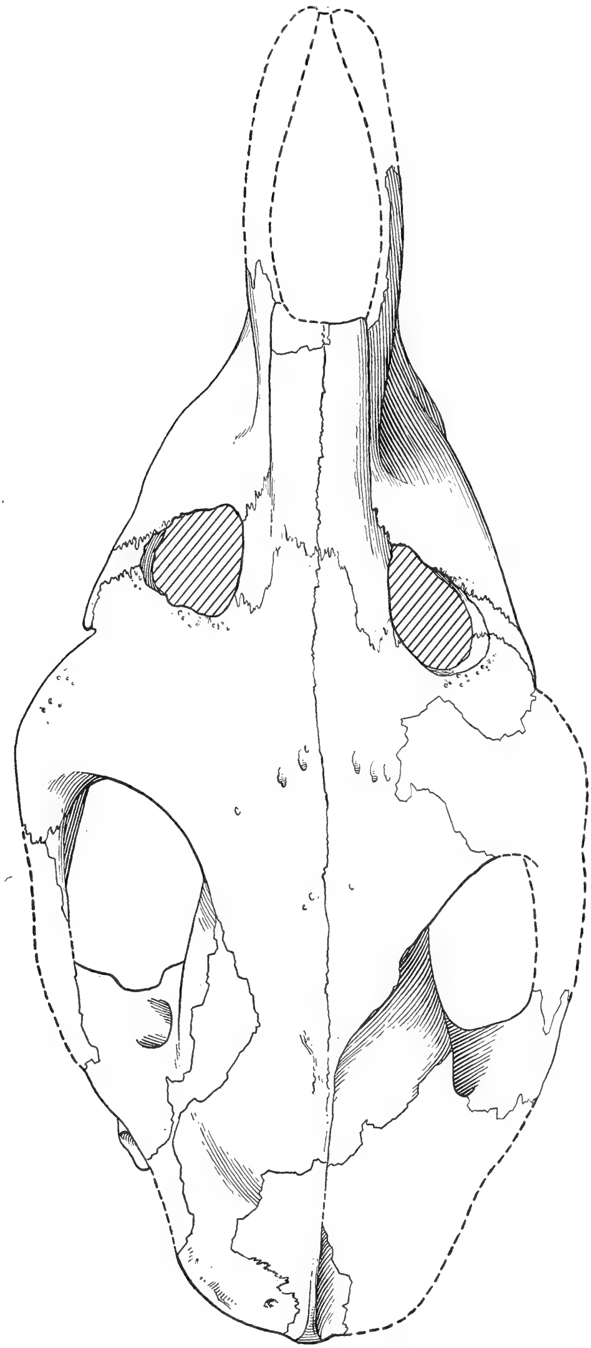


Fig. 17. *Pliauchenia gigas*, type skull, one third natural size.

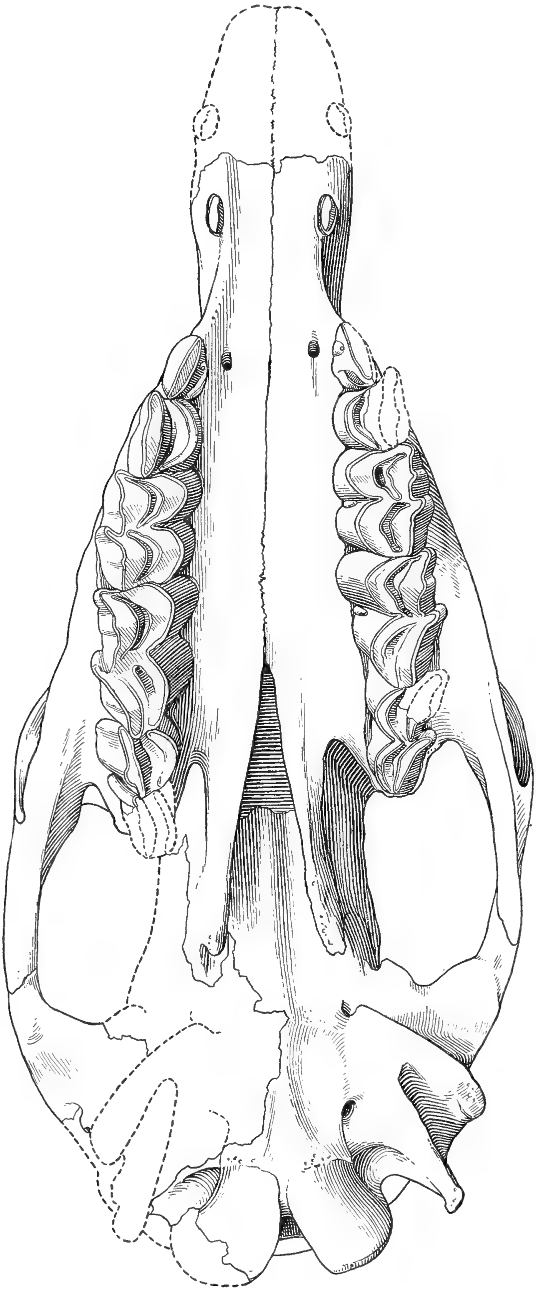


Fig. 18. *Pliauchenia gigas*, type skull, one third natural size.

individual. It is about one-fourth larger than the ulno-radius of the Bactrian camel, straighter and proportionately heavier in the shaft, the articular extremities less expanded, the olecranon projecting less backward and more upward. A second ulno-radius agrees closely with the first, There are numerous astragali, calcanea and other carpal and tarsal bones. incomplete metacarpals and metatarsals, agreeing in proportions with these ulno radii and indicating a camel one-fourth larger lineally than *Camelus bactrianus*, with straighter limb-bones, relatively longer metapodials considerably less expanded at the distal ends, phalanges much less flattened and expanded. The more compressed phalanges are suggestive of *Auchenia*, but the expansion of the distal ends of the metapodials is much less than in that genus.

Relationships.— The characters of skull and teeth show much nearer approach to *Auchenia* than to *Camelus* and in various respects stand nearer to *Procamelus* than to either genus. The large size, position of the orbits, short heavy muzzle etc. may be regarded as specializations of an independent sub-phylum, possibly terminating in one of the species of *Camelops* or *Eschatius* — but we have not considered these as generic characters.

Measurements.

	mm.
Skull, total length, premaxillæ estimated	523.
width at orbits	212.
depth at molars	170.
width of palate including molars	135.
height of occiput including condyles	134.
width " " at root of paroccipital processes	116.
length of zygoma, post. border of orbit to posterior margin of glenoid articulation	121.
width of orbit	63.
length of postcanine diastema	est21.
" diastema behind c^1	50.
Dentition, p^3–m^3, length	179.
length of true molars	133.
(measurements taken at base of crown)	
P^3, anteroposterior 23; transverse	17.
P^4, " 30; "	25.
M^1 " 33; "	39.4
M_2 " est 45; "	41.
Ulnoradius, length including olec anon	759.
" diameter of distal end	108.
" least transverse diameter of shaft	73.
Astragalus, length 112; transverse diameter	77.
Calcaneum " 176;	
Metacarpus, transverse diameter, proximal end	87.
Metatarsus, " "	79.

Largest complete phalanx, length 128 mm.; diameter of head 52 mm.

Alticamelus.

The type of this genus is *Procamelus altus* Marsh. An examination of the type specimen of this species shows that it is much less complete than would be inferred from Marsh's description, and consists solely of a calcaneum. The calcaneum is probably distinct specifically from the Colorado specimen referred to it by Matthew in 1898, but is indeterminate generically. The Colorado specimen which consists of part of skull, lower jaws, neck and hind limbs and feet may under these circumstances be regarded as a neotype of the genus although not of its type species. It has been renamed by Matthew (1909) *A. giraffinus.*

Alticamelus procerus sp. nov.

Type, No. 14070, a crushed skull and jaws with parts of the skeleton associated, found by W. D. Matthew in the Snake Creek beds.

This species is of medium size among the later Tertiary camels, considerably smaller than *A. giraffinus.* The skull is about one fifth longer than that of *Procamelus occidentalis,* the limb bones nearly twice as long.

Skull and *jaws.*— The skull is rather long and slender, but owing to the crushing, its proportions cannot be very exactly stated. The lachrymal vacuity is small; the fossa in front of it deep and sharply outlined, in marked contrast to *Procamelus, Pliauchenia, Auchenia* or *Camelus,* but in agreement with the *A. giraffinus* and with *Oxydactylus.* The lower jaw is moderately deep, the angular hook prominent. The skull is about as long as that of *Camelus arabicus* but very much slenderer throughout. The entire length of the dental series is greater than in *C. arabicus* but the individual teeth are much smaller.

Dentition.— The teeth are very well preserved, and are but little worn. Incisors 1 and 2 are absent; the next three teeth ($I^{\underline{3}}$, $C^{\underline{1}}$, $P^{\underline{1}}$) are caniniform with moderately long diastemata behind each. The premolars are much less reduced than in *Procamelus,* especially $p\frac{2}{2}$ The inner crescent of $p^{\underline{2}}$ is incomplete, that of $p^{\underline{3}}$ complete, but low. The molars are less hypsodont than in *Procamelus,* the parastyle, mesostyle and anterior external rib more prominent, although hardly as much so as in *Pliauchenia gigas.* The detailed characters of the premolars and molars show a marked resemblance to those of *Oxydactylus,* except for the considerably longer crowns.

Limbs.— The fore limb is represented only by parts of the humerus, ulno-radius, metacarpus and the proximal phalanges. These indicate a long slender limb, but stouter throughout than the hind limb. The tibia and

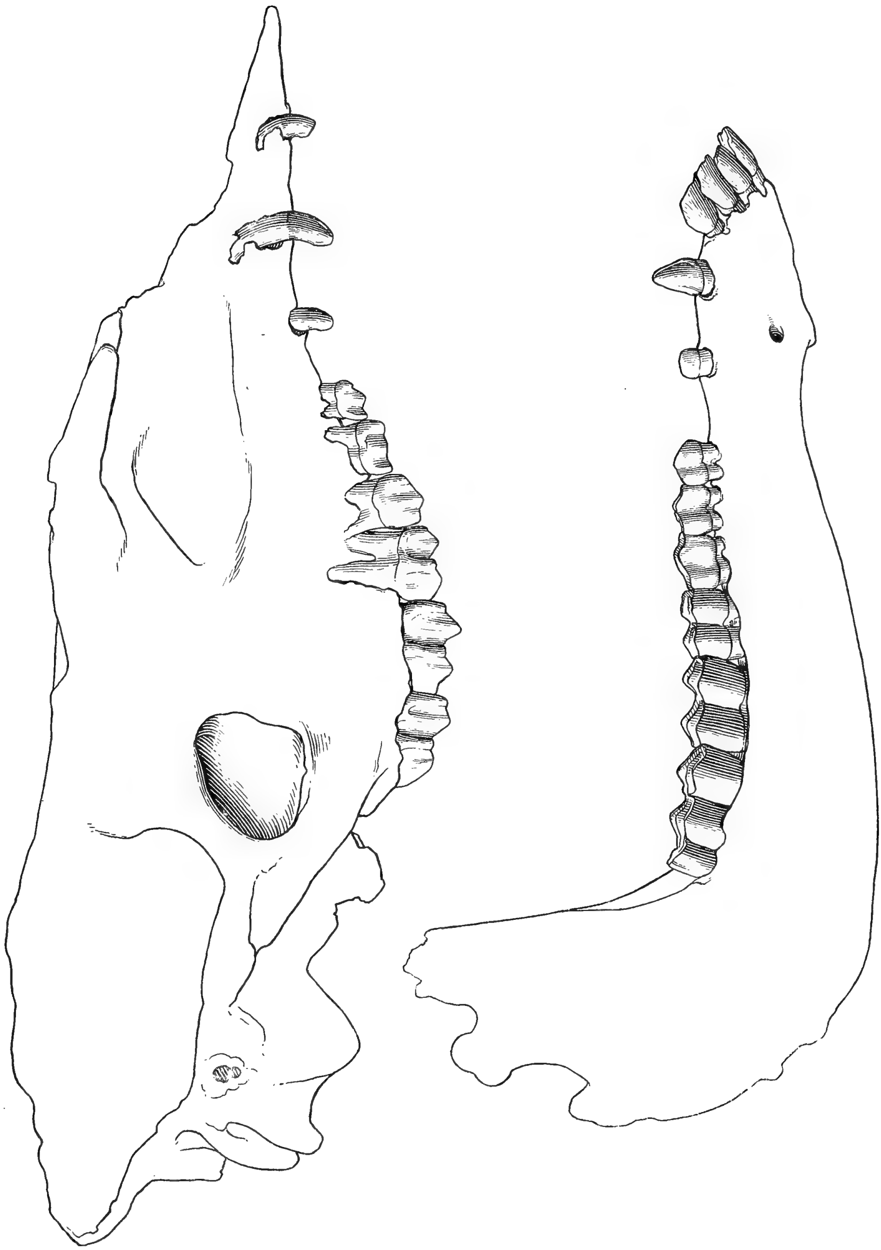


Fig. 19. *Alticamelus procerus*, skull and jaw of type, one third natural size.

metatarsus are preserved entire, with the astragalus, proximal phalanges and parts of the femur. The tibia is about a third longer than that of *Camelus arabicus* about the same size in the shaft, but not nearly as heavy at proximal or distal ends. The cnemial crest is much more prominent, but extends no further down the shaft. The metatarsus is a little shorter than the tibia but nearly a half longer than the metatarsus of *C. arabicus,* although less than three fourths as wide at proximal and distal ends. The cuboid and lesser cuneiform facets are not flattened out as in *Camelus.* The astragalus is shorter and proportionately narrower than in *C. arabicus.* The proximal phalanx of the fore foot is longer but very much narrower than in *C. arabicus*; that of the pes is of about the same length as in the modern species but much narrower, especially distally.

Several dorsal vertebræ and ribs are preserved, but they have not been extracted from the matrix. They indicate a much smaller body than that of *C. arabicus.*

Measurements of Type

		mm.
Skull, extreme length, premaxilla to occiput		480.
Length of dentition, i^3–m^3		260.
Length of lower dentition i^3–m^3		278.
Lower jaw, length, incisors to angular process		377.
" depth in front of p_2		34.
" " beneath m_2		45.
Diastema behind i^1		28.
" c^1		25.
" p^1		23.
Upper cheek teeth p^2–m^3		157.
Upper premolars p^2–p^4		63.
" true molars		98.
P^2, anteropost rior	18; transverse	9.5
P^3 "	20; "	12.
P_4 "	20; "	19.
*M^1 "	23; "	22.
*M^1 "	33; "	28.5
*M^3 "	34; "	27.
Lower cheek teeth, p_2–m_3		164.
" premolars p_{1-4}		94.
" true molars, m_{1-3}		108.
P_2, anteroposterior	16; transverse	7.4
P_3 "	19; "	8.8
P_4 "	23; "	12.3
*M_1 "	26; "	16.5
*M_2 "	31; "	20.
*M_3 "	47; "	22.

*Measurements taken at base of crown.

	mm.
Metacarpus width proximal end	61.
" " distal end	74.
Phalanx of manus, length	108.
" width proximal end	36.
Tibia, length	618.
" width of proximal end	96.
" " distal "	75.
Metatarsus, length	552.
" width proximal end	53.
" " distal "	73.
Phalanx of pes, length	98.
width proximal end	33.
Astragalus, length	71.
" transverse diameter	47.

From the parts preserved it would appear that *A. procerus*, with a much smaller body and slenderer limbs than the dromedary, must have stood at least two feet higher in the back. The neck was probably correspondingly longer than in the camel, and the head very slender and long. The proportionate length of fore and hind limbs is not yet known in *Alticamelus*, but as shown by Matthew in 1901 they were probably of equal length, as in the camels generally, instead of the fore limbs being longer as in the giraffe.

Alticamelus sp. div.

At least two smaller species of this genus are indicated by limb and foot-bones, and various fragments of jaws and teeth. There are three long slender metacarpal cannon bones successively decreasing in size from *A. procerus*; various incomplete metatarsal bones may be correlated with these, but doubtfully. A lower jaw with p_2–m_3 may be correlated with the largest of the three metacarpals; also a humerus and a very long and slender radius and several less complete limb bones. The third and smallest metacarpal has somewhat more the proportions of *Procamelus* and may be referable to that genus. None of these agree with any described species of camel with which comparison can be made.

Measurements.

Alticamelus sp. No. 1, indesc.

	mm
Lower jaw, No. 14072, length p_2–m_3	143.
" " " p_{1-4}	98.
" " " m_{1-3}	95.
Metacarpus No. 14081, length	484.
" " width at proximal end	58.5
" " " distal "	72.

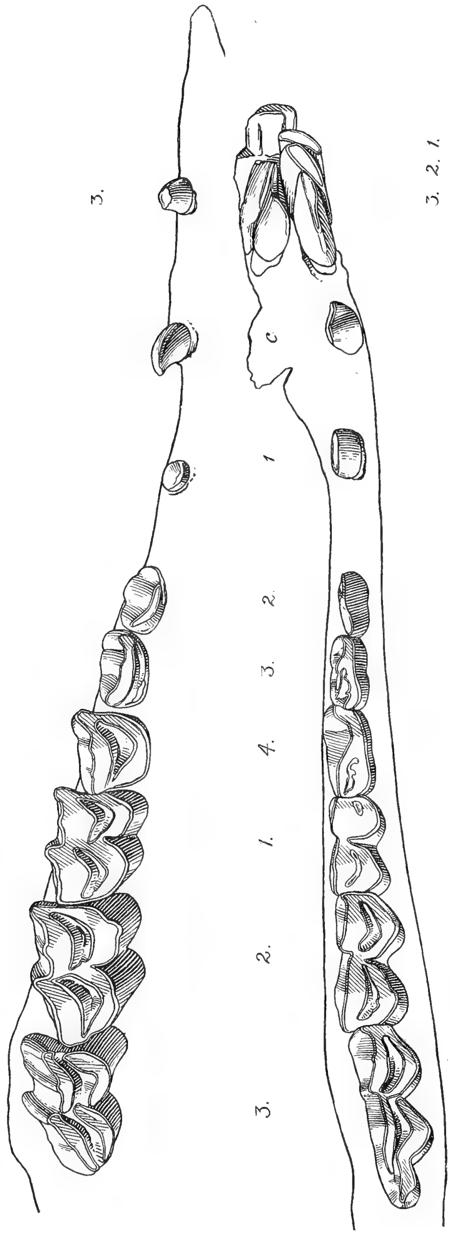


Fig. 20. *Alticamelus procerus*, upper and lower dentition of type, crown views, one half natural size.

		mm.
Ulnoradius No. 14093,	length exclusive of olecranon	494.
" "	width of distal end	61.5
Humerus No. 14099,	length	333.
" "	width proximal (anteropost.)	101.
" "	" distal end (transverse)	61.

Alticamelus sp. No. 2 indesc.

Metacarpus No. 14082,	length	399.
" "	width at proximal end	52.
" "	" distal "	65.

Alticamelus vel. **Procamelus** sp. indet.

Metacarpus No. 14083,	length	372.
" "	width of proximal end	58.
" "	" distal "	72.
Metatarsus No. 14084,	length	357.
" "	width of proximal end	49.
" "	" distal "	63.

This species has more the proportions of *Procamelus* in the shorter shaft and more expanded proximal and distal ends. We are unable to satisfactorily correlate any of the varied jaw fragments of appropriate size, in all of which the tooth formula is that of *Procamelus* and *Alticamelus*, but the reduction of the premolars agrees better with the former genus.

? **Procamelus** sp. div.

Numerous limb bones, metapodials, jaw fragments etc. indicate at the least two smaller species which are comparable in size to some of the smaller *Procameli*. It appears to be hopeless in the present state of our knowledge to make any satisfactory correlation of these small forms. There is some reason to believe from the manner in which these bones fall into groups, that the proportions of fore and hind limbs are reversed in these small types as compared with the larger forms. In the immature cannon bones of the smallest type, the metapodials are separate.

CERVIDÆ.

Parts of jaws, teeth, and various bones of the skeleton indicate several different species of Cervidæ.

Palæomeryx sp.

The largest form, represented by fragments of three lower jaws and several separate upper and lower teeth. Nos. 14123, 14124, (14125). This species agrees rather nearly with the figures and descriptions of *P. bojani* and *Kaupi* as given by Meyer (1834). It measures slightly larger than *P. bojani,* the heel of m_3 is broader and the inner cusp more distinct and prominent, the "Palæomeryx fold" is prominent on m_1, variable on m_2,

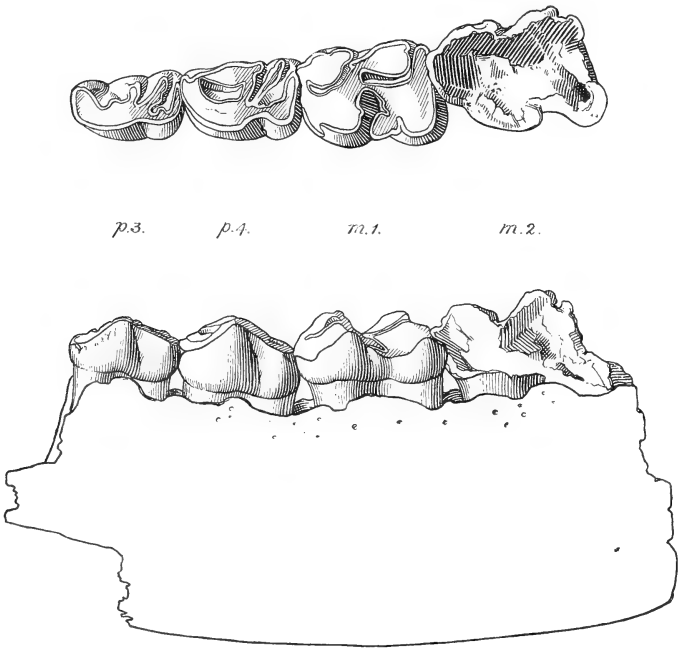


Fig. 21. *Palæomeryx* sp. indesc. Part of lower jaw, No. 14123, natural size, external and crown views of teeth.

vestigial on m_3. This species is probably most nearly related to the American Miocene "*Blastomeryx*" *borealis* and *antilopinus, Palæomeryx americanus* and *madisonius.* The characteristic broad heeled m_3 is found in jaws from the Middle Miocene of Colorado. None of these is as large as the Snake Creek form. Mr. J. W. Gidley has called our attention to the suggestive resemblance to *Alces* shown in the construction of the molars in this group of deer.

Measurements.

				mm.
No. 14123.	Length p_3–m_2			67.
"	P_3, anteroposterior	14.5;	transverse	9.
"	P_4 "	15. ;	"	10.
"	M_1 "	17. ;	"	14.
"	Depth of jaw beneath m_2			33.
No. 11425.	M_1 anteroposterior	17.5;	transverse	13.3
"	M_2 "	20.5;	"	14.6
No. 11424.	M_2 "	20. ;	"	14.2
"	M_3 "	30.8;	"	15.
"	" width of heel			11.

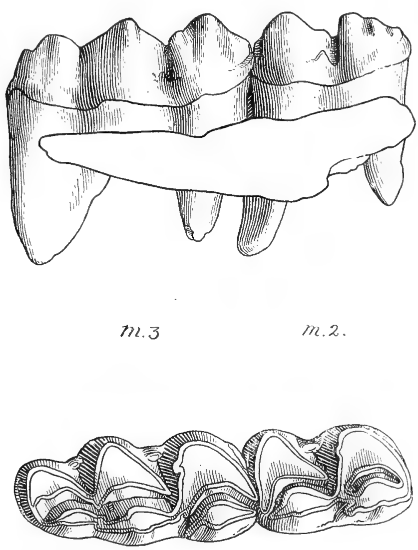


Fig. 22. *Palæomeryx* sp. indesc. Lower molars, No. 14124, natural size, internal and crown views.

Cervus sp.

A second form, somewhat smaller than the preceding, is represented by jaw fragments and teeth, Nos. 14126, 14127. These lack the "Palæomeryx fold" in the lower molars, the heel of m_3 is narrow and its internal cusp less prominent, the teeth are slightly less brachydont, and the surface of their enamel less rugose. The reference to *Cervus* is only in a broad sense; they might with equal propriety be referred to *Odocoileus, Mazama, Cervus* s. s., *Dama*, or to Schlosser's genus *Cervavus*.

A very similar but smaller species occurs in the Upper Miocene of South Dakota; it has not received a name.

Blastomeryx elegans sp. nov.

A lower jaw, No. 14101, represents a species of this genus about the size of *B. gemmifer* but with a more advanced type of dentition. The last molar is higher and more compressed than in the type of *B. gemmifer,* or in the referred specimen No. 9449; the dentition is one fifth larger than in the latter, the p_2–$_3$ relatively smaller. The molars are about a sixth smaller than

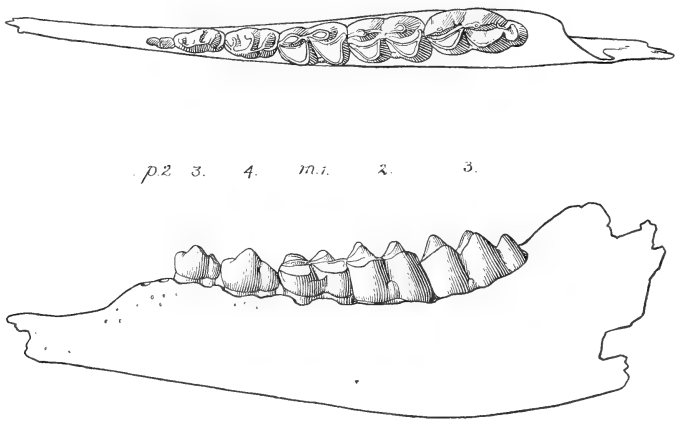


Fig. 23. *Blastomeryx elegans*, lower jaw, type specimen, natural size, external and crown views of teeth.

in *B. wellsi,* the premolars less reduced, the cingular crest of the anterior margin of the molars less prominent. In these respects it agrees more nearly with the Middle and Lower Miocene species, but the pattern of the premolars is more like that of *B. wellsi*; in particular the deuteroconid of p_4 is distinct and prominent.

Measurements.

			mm.
Lower cheek teeth, p_2–m_3			49.5
true molars m_{1-3}			32.
P_3, anteroposterior	6.2;	transverse	3.
P_4 "	7.3;	"	4.
M_1 "	9. ;	"	5.2
M_2 "	10.3;	"	5.9
M_3 "	13.9;	"	5.6

Depth of jaw at diastema, 6.2; beneath p_3, 12.2; beneath m_3, 15.8.

Blastomeryx cf. **wellsi**.

Three lower molars, No. 14118, agree with this species in size and otherwise so far as comparison is possible, except that the anterior cingular crest is even more prominent.

ANTILOCAPRIDÆ.

Merycodus.

This genus is rather common, being represented by sixteen lower jaws, numerous teeth, limb-bones, cannon-bones, etc., with a couple of fragments of antlers. Most of the material belongs to a single species which for the present we regard as a variety of *M. necatus.* A much larger and a much smaller species are also represented — both of doubtful generic reference.

Merycodus necatus sabulonis var. nov.

The type of *Merycodus necatus* Leidy, 1854, is from Bijon Hills, and consists of a fragment of the lower jaw with p_4–m_1. Leidy subsequently (1869) figured a lower jaw with p_3–m_3 which he referred to this species. The series of lower jaws in our collection, Nos. 14102–17, run uniformly smaller and slenderer than Leidy's specimens, and better material might show them to be distinct specifically. They show some degree of variation

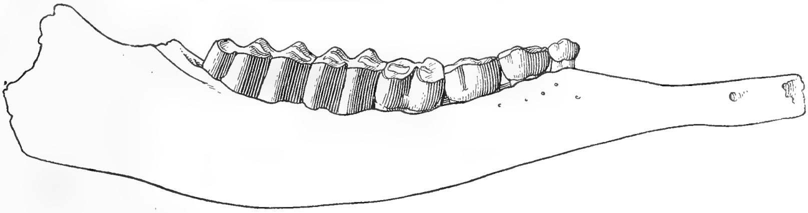


Fig. 24. *Merycodus necatus sabulonis*, lower jaw, type specimen, natural size, external view.

in robustness and size, aside from the variations in proportion of the teeth which are due to age, but are from ten to twenty per cent. smaller, and the two posterior inner crests of p_4 are less distinct than in Leidy's figure. In the absence of a satisfactory topotypic series of *M. necatus*, it appears inadvisable to regard these differences as more than varietal. A large series of limb and foot-bones, Nos. 14125, 14132, agrees pretty nearly in size with the

better known species *M. osborni*, except that the fore-limb bones are somewhat smaller, as is the jaw. The fragments of antlers agree so far as they can be compared, with *M. osborni*, better than with *M. furcatus*, or the antlers referred to *M. necatus*.

Measurements of eight adult Jaws.

Catalogue Nos. of specimens:	14103	14104	14105	14108	14109	14110	14111	14112
Lower jaw, total length	111.		108.			119.		
Lower cheek-teeth, p_2–m_3	44.	47.	46.	47.	48.	46.	47.	46.
" premolars p_{2-4}	17.		17.		18.	16.5		18.
" molars m_{1-3}	27.	30.5	29.	28.8	30.	30.	29.5	28.
Depth of jaw at diastema	6.	6.	6.	7.	6.	7.	6.	6.
Length of m_3	13.	14.	13.	12.5	13.	14.5	12.	13.

The variation in the above series appears to be partly due to age and partly to individual difference.

? **Merycodus** sp.

A third upper and a third lower molar, Nos. 14121, 14119, indicate a species about one half larger than the preceding. The upper molar is very doubtfully referable to *Merycodus*, as it approaches *Antilocapra* in the large size of the posterior lobe and narrowness of the tooth.

? **Merycodus** sp.

A metatarsal cannon bone, No. 14131, is much smaller than any described species of *Merycodus* or *Blastomeryx*, scarcely larger than *Leptomeryx*

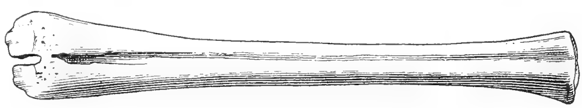


Fig. 25. ? *Merycodus*, sp. indesc., metatarsus, No. 14131, natural size.

evansi or *Tragulus*. It is adult, and agrees in characters with *Merycodus* and *Blastomeryx*, representing probably some very tiny species of Pecoran.

	mm.
Length of metatarsal cannon bone	73.
Diameter of proximal end	9.2
" distal end	11.9

Bovidæ.

Neotragocerus gen. nov.

This genus includes antelopes with short straight horns and brachydont teeth, a combination of characters not found in any living groups, but characteristic of the Tragocerine group of the late Miocene and Pliocene reported hitherto only from Europe, Asia and Africa.

The horns are shorter and straighter than in *Tragocerus* or in any of the modern goats (? *Nemorhædus* excepted). The upper molars resemble those of *Tragocerus* and various other extinct genera which have been recorded by different European authors.

Neotragocerus improvisus sp. nov.

Type a complete horn-core, No. 14141. Paratypes, two upper jaws displaying the molar teeth, Nos. 14136 and 1413.

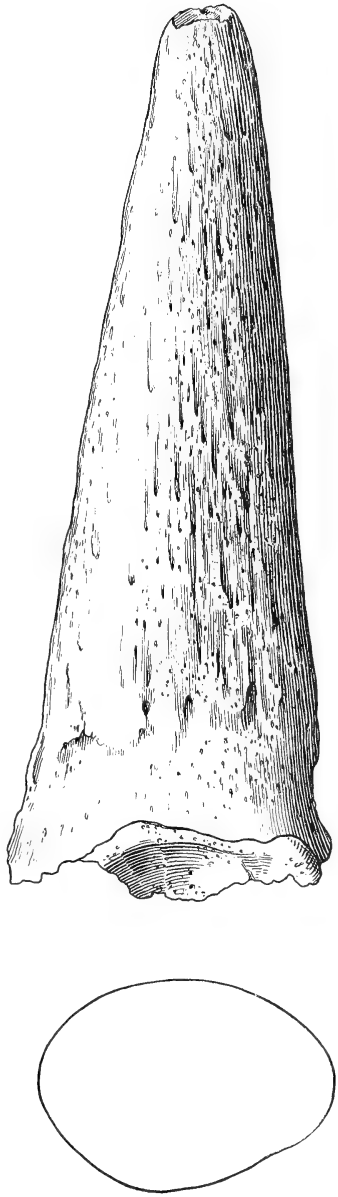


Fig. 26. *Neotragocerus improvisus*, horn-core, type specimen, natural size

The discovery of an unmistakeable bovid horn was a most unexpected feature of this fauna. The horn is about $4\frac{1}{3}$ inches long, $1\frac{1}{2}$ inches in diameter at the base, round-oval in cross section and perfectly straight. Its surface is that of the horn cores of Bovidæ, easily distinguished from the horn core of the Pronghorn Antelope by the coarser and less compact structure of the surface, and quite unlike any Cervid antlers in surface. It approaches *Oreamnus* in form and surface about as nearly as any modern genus with which we have made comparison, but lacks the curvature of that genus. In the entire collection there are no

hypsodont bovid teeth of appropriate size, but there are two upper jaws and a number of upper and lower teeth which do not agree with either Cervidæ or Camelidæ, and do agree quite nearly with some of the brachyodont antelopes. The correlation of these with the horn-core is of necessity provisional, but, if correct, indicates a type of antelope nearly related to the Pliocene

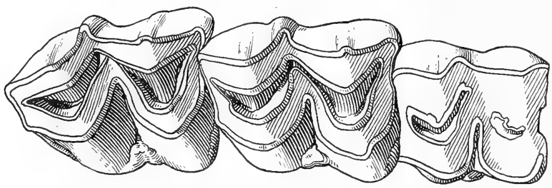


Fig. 27. *Neotragocerus* cf. *improvisus*, upper molars, paratype, No. 14136.

antelopes of the Old World, and retaining a primitive type of teeth and of horns which are not found together in any modern Bovidæ. The short straight untwisted horns are retained in the Cephalophinæ, Caprinæ, etc., but always associated with long-crowned teeth; the short-crowned teeth are retained in the Hippotraginæ but associated with long, spirally twisted horns.

? **Bovid**, gen. indet.

A few bones of the feet indicate a species considerably larger than *Neotragocerus improvisus*, and nearly equalling the musk-ox in size. They may belong to *Palæomeryx*, but appear to be too large for the teeth referred to that genus, and agree better in proportions with the larger antelopes.

Bison sp. indesc.

Part of a lower jaw, No. 14135, is unquestionably referable to this genus and differs from the modern American species and from *B. occidentalis*, in the somewhat simpler structure of the crescents, and larger, more compressed heel of m_3. The petrifaction of this specimen is less complete than in practically all the specimens of the collection, although there are a few which, while certainly referable to Miocene or early Pliocene species, are in about the same stage of petrifaction as the bison jaw. There is no doubt as to its being taken from the same quarry and in the same level as a large number of characteristic specimens of the fauna described in these pages. But in view of the residual nature of the deposit, the possibility of accidental intermixture of specimens of later age must be kept in mind, and in absence of any confirmatory evidence we do not regard the presence of this Pleistocene genus in the Snake Creek fauna as satisfactorily proven.

56.9,74(1181:62)

Article XXVIII.— NEW CARNIVOROUS MAMMALS FROM THE FAYÛM OLIGOCENE, EGYPT.

By Henry Fairfield Osborn.

In an earlier contribution [1] describing the results of the American Museum expedition to the Fayûm a number of new mammals were described briefly, as follows:

Ptolemaia lyonsi	*Metaphiomys beadnelli,*
Phiomys andrewsi,	*Apidium fayumensis.*

The entire mammal collection, consisting of about 500 specimens, has now been very carefully worked up by Mr. Walter Granger, assisted by Mr. George Olsen. A collection received from Herr Richard Markgraff has also been prepared, but description is deferred out of courtesy to Professor Eberhard Fraas of Stuttgart, whose attitude toward our researches and explorations has been most cordial.

The writer is especially indebted to Mr. Walter Granger not only for the careful manner in which this material has been worked up, but also for valuable advice in the preparation of this second contribution.

Order CREODONTA.

Family Hyænodontidæ.

The American Museum collection is especially rich in the remains of carnivores, all of which belong to the archaic order Creodonta. There are altogether twenty-five specimens of jaws and skulls, chiefly from the lower beds. Besides the species of *Pterodon* and *Apterodon* described by Andrews, there are a number of new species and one new genus of Creodonts, all belonging to the family Hyænodontidæ but presenting a great diversity of form.

Genus **Apterodon** *Fischer.*

Syn.: *Dasyurodon* Andreæ.

The only figure of this animal is that of a jaw given by Andreæ,[2] con-

[1] 'New Fossil Mammals from the Fayûm Oligocene, Egypt.' Bull. Amer. Mus. Nat. Hist., Vol. XXIV, Art. xvi, Mar. 25, 1908, pp. 265–272.

[2] Bericht Senckenbergische natur. Gesellschaft, 1887, p. 125, pl. iv.

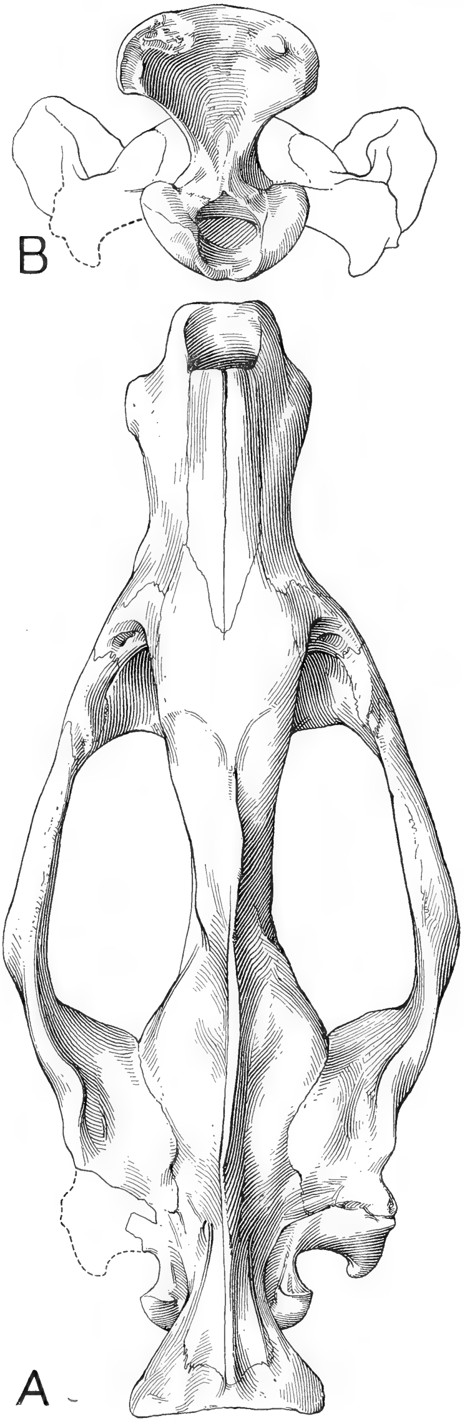


Fig. 1. Skull of *Apterodon macrognathus*, Amer. Mus. No. 13236. One-half natural size. A. Top view. B. Posterior view.

taining p_3, p_4, and m_2, m_3. In the molars of this specimen (type of *D. flonheimensis*) the talonid is sharp or laterally compressed, bearing a single cusp. We fortunately possess two skulls showing the entire upper series of teeth, which afford a new definition as follows:

Generic characters. Lower molars with paraconid, protoconid and more or less complex talonid. Upper molars triangular, as in *Tritemnodon* and *Sinopa,* with protocone prominent, subequal paracone, metacone, and styles. Teeth tubercular rather than sectorial.

Apterodon macrognathus *Andrews.*

A jaw (Amer. Mus. No. 13241, Fig. 9, E.) found in Quarry A agrees closely in measurements with Andrew's type of this species.

Measurements.

	cm.
Series of true molars	4.85
Second premolar to third molar inclusive	9.8

The first lower premolar is represented by an empty alveolus, a feature observed in all these specimens. The premolar and molar cusps are of somewhat rounded form. The jaw is long and rather shallow, measuring 21.8 cm. from the posterior border of the canine alveolus to the condyle, and 9.8 cm. from the coronoid to the lower border.

A perfect skull (Amer. Mus. No. 13236) may be provisionally referred to this species (Fig. 1). It is of a typical dolichocephalic form, the cranium being greatly produced back of the orbital and dental region. The posterior nares are enclosed in a tubular elongation of the palatines, behind which the pterygoids surround a deep fossa. The high, thin sagittal crest, elevated occiput, and contracted brain case complete the aberrant character.

Measurements.

	cm.
Occipital condyles to incisive border	27.7
Width across zygomatic arches	11.95
Series of seven molars and premolars	8.82
Three true molars	3.57

Other specimens of inferior size are the skull Amer. Mus. No. 13237, represented in Fig. 2, which may belong to a female, and the lower jaws, Amer. Mus. Nos. 13239, 13240, 13242, 13245, 13246. The marked disparity in the size of the skull from the one above mentioned is indicated in the following measurements:

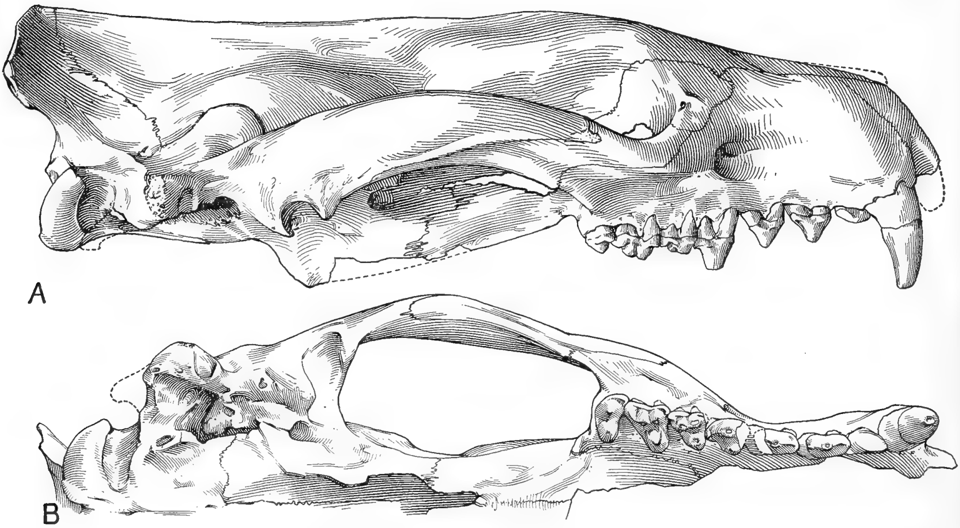


Fig. 2.

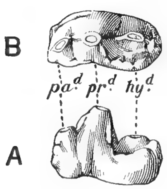


Fig. 3.

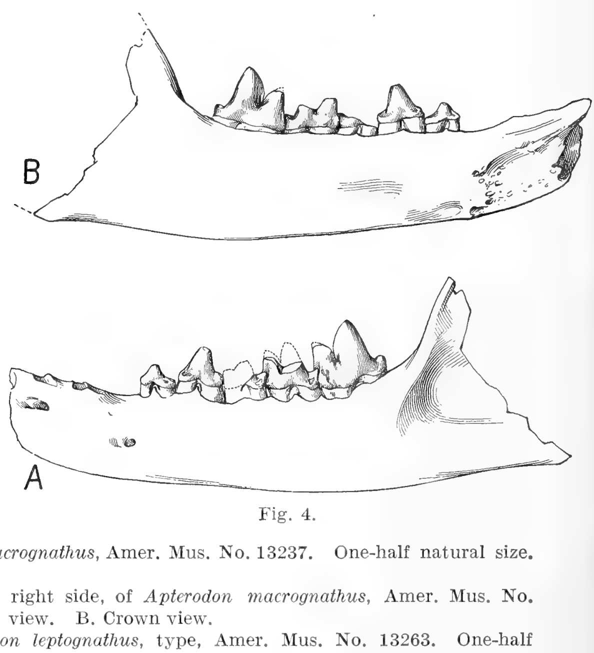


Fig. 4.

Fig. 2. Skull of *Apterodon macrognathus*, Amer. Mus. No. 13237. One-half natural size. A. Side view. B. Palatal view.

Fig. 3. First inferior molar, right side, of *Apterodon macrognathus*, Amer. Mus. No. 13242. Natural size. A. Internal view. B. Crown view.

Fig. 4. Lower jaw of *Pterodon leptognathus*, type, Amer. Mus. No. 13263. One-half natural size. A. External view. B. Internal view.

	cm
Incisive border to occipital condyles, est.	23.5
Width across zygomatic arches, est.	11.
Series of seven premolar-molar teeth	7.6
True molar teeth	2.87

The first and second superior molars in both these skulls (Amer. Mus. Nos. 13236, 13237) are sub-triangular, of tritubercular type, with prominent internally placed protocones, subequal parastyles and metastyles. M^3 is a simpler, transversely placed tooth, composed of protocone, paracone, and spur-like parastyle. The cusps are rounded and conical as compared with those of other members of this family, approaching the type displayed in the Mesonychidæ.

The first inferior molar (Fig. 3) is most perfectly preserved in the immature jaw of another specimen (Amer. Mus. No. 13242), in which the primitive character of the trigonid and talonid are displayed, the latter exhibiting vestiges of three cusps, as in primitive Creodonts generally. This tricuspid character contrasts with the simple trenchant cusp on the talonids of M_{2-3} of Andreæ's type.

Genus **Pterodon** *DeBlainville.*

Pterodon africanus *Andrews.*

This more powerful Creodont is represented by two lower jaws (Amer. Mus. Nos. 13257, 13258; Fig. 9, A.) which agree with the measurements and figures of Andrews.

Measurements.

	No. 13258	No. 13257
	cm.	cm.
Six inferior premolar-molar teeth, est.	15.5	16.
Space occupied by three premolars	8.	8.3
" " " true molars, est.	7.5	7.7

This animal is characterized by a robust jaw, powerful symphysis, and very large canines. It is the most powerful carnivore hitherto discovered in this formation.

To this species may be referred perhaps a somewhat fragmentary specimen (Amer. Mus. No. 13251).

Pterodon leptognathus sp. nov.

The type of this species is a slender jaw (Amer. Mus. No. 13263, Fig. 4; Fig. 9, C.) of intermediate size, found in Quarry A of the lower beds.

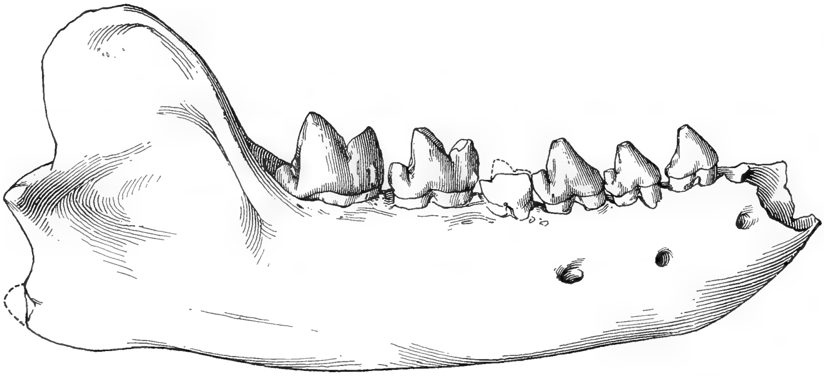


Fig. 5.

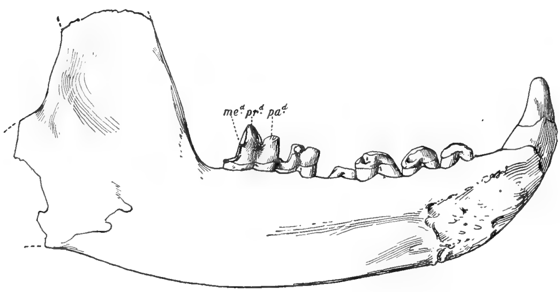
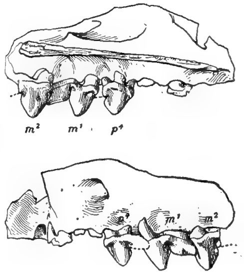


Fig. 6.



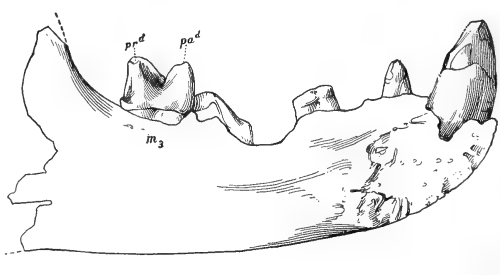


Fig. 7.

Fig. 8.

Fig. 5. Type jaw of *Pterodon phiomensis*, Amer. Mus. No. 13253. External view. One-half natural size.

Fig. 6. Lower jaw of *Metasinopa fraasii*, type, Amer. Mus. No. 14453. Internal view. One-half natural size.

Fig. 7. Left maxilla of ?*Metasinopa*, Amer. Mus. No. 14452. One half natural size.

Fig. 8. Lower jaw of *Hyænodon brachygnathus*, type, Amer. Mus. No. 13264. Internal view. One-half natural size.

The name is assigned in reference to its elongate character, evidently associated with dolichocephaly.

Characters. P 4, M 3. The first premolar is represented, as in all the other specimens, by an empty alveolus. Behind a narrow interval is the second bifanged premolar, which in turn is separated by a considerable interval from the greatly reduced, laterally compressed, and bifanged third premolar, which exhibits only a very rudimentary posterior basal cusp. The fourth premolar is slender, with a posterior basal cusp. Reduction and spacing of the premolars appears to be a distinctive character of this animal. The lower true molars exhibit the typical *Pterodon* character, except that the talonid is more reduced than in *P. africanus* or *P. phiomensis.*

Measurements.

	cm.
Space occupied by seven premolar teeth	9.2
" " " four inferior premolars	5.05
" " " three " molars	4.15

Pterodon phiomensis sp. nov.

The type of this species is the nearly perfect lower jaw (Amer. Mus. No. 13253; Fig. 5; Fig. 9, B.) discovered in Quarry A of the lower beds. It represents an animal of two-thirds the size of *P. africanus* and of a more slender, compressed jaw type. It is the same size as *Pterodon dasyuroides* from the Phosphorites of Quercy, but is distinguished by the more trenchant character both of the premolar and molar teeth. The jaw is moderately deep and powerful.

Measurements.

	cm.
Space occupied by six premolar-molar teeth	11.35
" " " three inferior premolars	4.8
" " " three inferior molars	6.55

Characters. As compared with the teeth of *P. dasyuroides* those of *P. phiomensis* are more laterally compressed, blade-like, and trenchant throughout. Both in m_2 and m_3 the talonid and protoconid form a more open blade than in *P. dasyuroides.* The coronoid process is simple and rounded, quite different in form from that of *A. macrognathus.*

The second specimen (Amer. Mus. No. 13254) of this species displays the same characters and contains a perfectly preserved m_1. Pm_1 is represented, as in *P. africanus,* only by a partly closed alveolus. P_{2-4} are laterally compressed. P_2 has a rudimentary posterior basal cusp. P_3 and p_4 exhibit narrow posterior (talonid) and rudimentary anterior (paraconid) basal tubercles. M_{1-3} exhibit a typical paraconid, protoconid, and hypoconid of the *Pterodon* molar type.

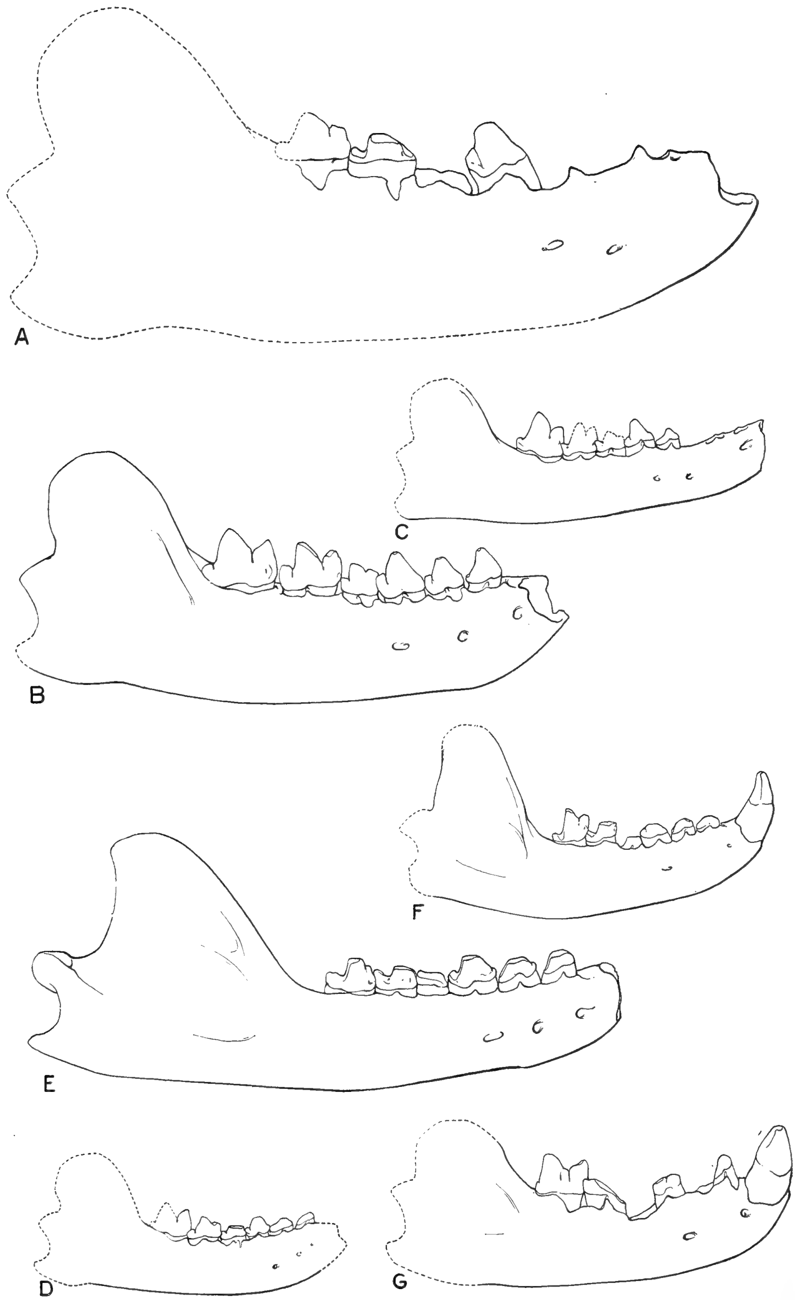


Fig. 9. Series of jaws of Creodonts. External view. All one-third natural size. A. *Pterodon africanus*, No. 13258. B. *Pterodon phiomensis*, type, Amer. Mus. No. 13253, partly restored from No. 13254. C. *Pterodon leptognathus*, Amer. Mus. No. 13263. D. *Pterodon* sp., Amer. Mus. No. 13262. E. *Apterodon macrognathus*, type, Amer. Mus. No. 13241. *Metasinopa fraasii*, type, Amer. Mus. No. 14453. G. *Hyænodon brachygnathus*, Amer. Mus. No. 13264.

Metasinopa gen. nov.

Metasinopa fraasii sp. nov.

The type of this species and genus (Amer. Mus. No. 14453; Fig. 6; Fig. 9, F.) is a nearly complete lower jaw from the upper beds.

Characters. P_3, M_3. As in *Pterodon* and *Apterodon* a basal talonid is preserved, which distinguishes this animal from *Hyænodon.* A persistent metaconid on m_2 and m_3 distinguishes this animal from *Pterodon* and *Apterodon* and relates it to *Sinopa* and *Tritemnodon,* the Eocene ancestors of this family of Creodonts. The lower premolars are small and p_1 absent. Heels of lower molars small, trenchant.

Measurements.

	cm.
Anterior border of canine to condyle	14.2
Series of six premolar and molar teeth	6.5

This animal is probably generically the same as that which Andrews provisionally referred to *Sinopa.* It agrees with Andrews's type of *S. ethiopica* in the retention of the metaconid on the inferior molars; it differs specifically from *S. ethiopica* in the greater breadth of the talonid and in its much greater size. The jaw is moderately deep.

Of somewhat doubtful reference to the same genus is the maxilla, Amer. Mus. No. 14452 (Fig. 7). This specimen apparently agrees with *Hyænodon* in the possession of but two superior molars. It differs in the presence of a vestigial protocone on m^1 and m^2, but still more decidedly in the less perfectly blade-like character of the paracone and metacone. It agrees in size with Andrews's type of *S. ethiopica.*

Measurements.

	cm.
Space occupied by four premolars, est.	2.85
" " " two molars, est.	2.45

Genus **Hyænodon** *Lazier and Parieu.*

The presence of *Hyænodon* in the Fayûm was suggested by Andrews from a single imperfect specimen. It is apparently more surely indicated by a nearly complete lower jaw (Amer. Mus. No. 13264, Fig. 8), the type of the species described below, which exhibits the deep, powerful, and abbreviated character seen in the species *H. brachyrhynchus* Filhol of the Phosphorites of Quercy. The reference to *Hyænodon* is based on the large size of the paraconid and the vestigial character of the talonid.

Hyænodon brachycephalus sp. nov.

This type (Fig. 8) is distinguished from the typical *Hyænodon* by the presence of a vestigial talonid on the third inferior molar.

Characters. The third inferior molar, m_3, exhibits only a cingulate vestige of the talonid, which is such a conspicuous character of all the contemporary specimens of *Pterodon* and *Apterodon* in the Fayûm. Moreover, the two blades of m_3, composed of the paraconid and protoconid, are subequal in size, whereas in *Pterodon* and *Apterodon* the protoconid is much the more prominent. The first premolar is entirely wanting, not being represented even by an alveolus, as in the specimens of *Pterodon* and *Apterodon.* The second premolar is a small or reduced tooth, still bifanged. The characters of the other teeth cannot be determined from this specimen.

Measurements.

	cm.
Canine to third molar	9.92
Space occupied by six premolar-molar teeth	7.6
" " " three inferior premolars	3.23
" " " " " molars	3.37

59.9(51.4)

Article XXIX.— MAMMALS FROM SHEN-SI PROVINCE, CHINA.

By J. A. Allen.

A small collection of mammals from Mount Tai-pai, Shen-si Province, China, recently acquired by the Museum through Mr. Alan Owston of Yokohama, contains several species of interest. It comprises 55 specimens, representing 16 species, some of which appear to be undescribed. The material is rather poorly prepared, the skulls having been left in the skins, and when removed were found to be more or less mutilated, some of them lacking the whole of the postorbital portion. The collection is of interest as coming from a hitherto unexplored locality, the Tai-pa-shiang mountains, on the western border of Shen-si, which are said to reach an altitude of about 11,000 feet. The specimens are mostly labeled simply "Tai-pa-shiang," with the sex of the specimen and date of collection, but a few are labeled as from "Yumonko, foot of Tai-pa-shiang," and others are marked "Si-Tai-pa-shiang." In no case is the altitude indicated.

1. **Budorcas taxicolor tibetanus** *Milne-Edwards*.— A horn of an adult and skins and skulls of two very young animals, Tai-pa-shiang, August 16 and October 25. The two specimens are respectively male and female, and differ much in color, the male having the body, except the ventral surface and the dorsal stripe, pale yellowish, the dorsal stripe, the ventral surface and limbs dark dull reddish brown; top of nose and edge of ears blackish. The other has the body nearly white, with the underparts and limbs dark brown; the dorsal stripe is dark brown only over the shoulders, and black mixed with white on the top of the neck and posterior two-thirds of the dorsal line; black hairs are also appearing on the limbs. Both specimens are in the first pelage of the young, but the older one (female) is apparently beginning to acquire the adult pelage, to which the black hairs of the dorsal stripe and limbs pertain.

2. **Næmorhedus**[1] **griseus** *Milne-Edwards*.— Two skins and skulls of very young males, Si-Tai-pa-shiang, July 29 and November 18, 1905. In

[1] *Næmorhedus* H. Smith, 1827; type *Antilope goral* Hardwick, by restriction of J. E. Gray (Ann. and Mag., XVIII, Oct. 1846, p. 232). After having gone over the ground carefully, I agree with Pocock (Ann. and Mag. Nat. Hist. (8), I, Feb., 1908, pp. 183–188) that the proper generic name of the Gorals is *Næmorhedus* H. Smith (syn., *Kemas* Ogilby and *Urotragus* Gray), and that the proper generic name of the Serows is *Capricornus* Ogilby, although Lydekker (P. Z. S., 1908, Pt. iv, April, 1909, p. 941) prefers not to follow his friend Pocock.

the younger specimens the milk premolars are still in place; in the other p^{1-2} and m^1 are just through the gum.

3. **Capreolus bedfordi** *Thomas.*— An old female (teeth greatly worn) in summer pelage, and two young in spotted coat, Tai-pa-shiang, July 17, 27, and August 3. In the old female the hairs of the whole median dorsal region are black tipped with read, the black more or less visible at the surface; nose with a broad black band as in *C. capreolus.*

4. **Lepus swinhoei filchneri** *Matschie.*— Seventeen specimens, Tai-pa shiang (about half are labeled as from Yumonko), May 22 (one specimen), July 29–August 5, and November 5–16. They appear to represent a paler form than the type of *L. swinhoei* Thomas,[1] from Chefoo, with a shorter rostrum, judging by Thomas's measurements of the skull and Swinhoe's [2] description of the external characters. They are provisionally referred to *Lepus filchneri* Matschie,[3] based on specimens taken at Hing-an-fu, a little to the northeastward from Tai-pa-shiang, in southern Shen-si.

The average measurements of 12 adult skulls (all of which unfortunately lack the occipital region) indicate a skull of the same zygomatic and inter-orbital width as the type skull of *swinhoei*, but with more tapering and shorter nasals and shorter rostrum. Thus the nasals average 4.5 mm. shorter on the outer border and 1 mm. narrower at the front border, while the diastema and palatine foramina average each 2 mm. shorter, and the distance from the postorbital notch to the tip of the nasals is 5 mm. less. It is impossible to make a proper statement of the color difference in the absence of specimens of the type form of *swinhoei* for comparison. The general effect of the ground color of the dorsal surface, in the same (fall) pelage as the type of *swinhoei*, is pale grayish fulvous instead of "clay-color" or, as later stated, "ochraceous buff." Furthermore, it is hardly probable that a form of hare should be the same at the extreme eastern end of the Chefoo Peninsula and at Tai-pa-shiang and the region adjacent, 1200 miles to the westward in the interior of the continent.

Of the present series, 7 specimens were taken in November (Nov. 5–16) and are thus in fresh fall pelage, while 7 are in worn summer pelage, having been taken in May (one example) and July 29–August 5 (six examples); the other three are young, one-eighth to about one-third grown. Six of the November specimens present little variation in color, the seventh being markedly paler in general ground color and on the pectoral collar. The summer specimens are in exceedingly worn pelage, from which the profuse black tips of the hairs seen in the fresh pelage have nearly disappeared, the

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[1] Ann. and Mag. Nat. Hist. (6), XIII, April, 1894, p. 364.

[2] Proc. Zoöl. Soc. London, 1870, pp. 449, 450.

[3] Expedition Filchner nach China und Tibet, Bd. X, T. i, 1908, pp. 217–219.

dorsal surface being only indistinctly punctated with black. The young are similar in coloration to the summer adults, but with much shorter and finer fur.

A prominent feature of the fresh fall pelage is the presence along the sides of the body of scattered long bristly white hairs, which project 30–35 mm. beyond the rest of the pelage, and thus are conspicuous by their length, whitish color and abundance.

It is possible that the Tai-pa-shiang specimens are different from those from the valley of the Hang-hiang River, and are thus not strictly referable to *L. filchneri.* In fact, I at first distinguished them from *L. swinhoei* as *L. swinhoei brevinasus* subsp. nov., with No. 27528, ♀ ad., as the type, but later suppressed the supposed new form on discovering that Matschie had already given a name to a geographically near form.

Since the above was written Mr. Oldfield Thomas has described [1] a pale form of *Lepus swinhoei* from the Ordos Desert, northern Shen-si, as *L. s. subluteus.* This paler desert form can hardly be the same as that from the mountains of southwestern Shen-si. Mr. Thomas thinks "there is no doubt *L. filchneri* should be referred to *L. swinhoei,*" and gives the range of *L. swinhoei* as "from Chefoo and Nanking westwards to southern Shen-si."

5. **Ochotona cansus** *Lyon.*— Represented by 10 specimens (skins with fragmentary skulls) taken May 11, 29, June 4, 5, 17, July 1, September 26, 28.

Five specimens, collected May 11–June 5, in worn pelage, are distinctly rufescent above and superficially white below without any tinge of fulvous, or any fulvous lateral band bordering the ventral surface. Another June specimen (June 4) is in mixed pelage, having acquired to a large extent the post-breeding dress; a specimen taken June 17, and another taken July 1, have nearly completed the change, as have the two September specimens. These show a little rufous on the top of the head, but not elsewhere, the general coloration above being a pale yellowish brown slightly varied with black-tipped hairs, and the ventral surface is yellowish white, strongest and tending to rufous on the median line. The sides of the neck in front of the shoulders are dull rusty fulvous, with a tendency to its extension posteriorly to the sides of the rump, which doubtless later, in full winter coat, is a feature of the coloration, as already well shown in one of the September specimens.

The specimens are provisionally referred to *Ochotona cansus* Lyon, based on a single specimen collected at Taoches, Kan-su, with which some of the specimens closely agree. The imperfect condition of the skulls renders difficult the satisfactory determination of the species, while the wide range of seasonal variation in color shown by the present series further complicates the problem.

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[1] Proc. Zoöl. Soc. London, 1908, 979, 980 (April, 1909).

6. **Micromys pygmæus** (*Milne-Edwards*).— One specimen, male (skull very much broken), foot of Si-Tai-pa-shiang.

7. **Myotalpa rufescens** sp. nov.

Type, No. 27549, ♀ ad., foot of Tai-pa-shiang, Shen-si, China, July 24, 1905; coll. A. Owston.

General color rufescent brown (cinnamon-rufous of Ridgway), the hairs being dusky slate conspicuously tipped with cinnamon rufous, both above and below, but most strongly on the dorsal surface. Nose with a truncated V-shaped spot of buffy white, 8 mm. long on the median line, 8 mm. wide on the front border and 5 mm.wide on the posterior border; rest of front of head to behind the eyes grayish brown, the orbital region clear gray and the crown darker with a rufescent tinge; upper surface of fore and hind feet well clothed, silvery grayish white, passing into darker proximally; tail well clothed, brownish white; middle claw of fore feet longest, the second intermediate between third and fourth; on the hind feet third and fourth claws longest and subequal.

Length of head and body in skin, 186 mm.; tail vertebræ, 33; hind foot (s. u.), 25, (c. u., 32); third claw of fore foot, 13. The skull is too imperfect for full measurements, it lacking the occipital portion and the greater part of palatal region. Diastema, 13.5; length of palatine foramina, 18; interorbital constriction, 7.3; lower jaw, length (incisive border to condyle), 31; height at angle, 20; lower toothrow, 11.

This species bears a general resemblance in external characters to *M. cansus* Lyon, from Taocheo, Kan-su, northwestern China, but is darker and more rufescent, and has the feet and tail more heavily haired. There are important cranial and color differences that seem to separate the present form from all those previously described. The rostrum is broad, and the nasals uniformly broaden apically, as in *M. fontanieri* as figured by Milne-Edwards,[1] from which, however, the nasals differ in greater posterior extension and deep posterior emargination, the latter feature being as shown in Milne-Edward's figure of his *Siphneus myospalax* (*l. c.*, pl. viii, fig. 5). In the present species, however, the nasals extend to a point slightly beyond the posterior border of the infraorbital foramen, as is not the case in any of the other species. From *M. cansus* it further differs in the form of the first upper molar, in which the inner loops are relatively much smaller than in *M. cansus*.

8. **Sciurotamias owstoni** sp. nov.

Type, No. 27545, ♀ ad., Tai-pa-shiang Mountains, Shen-si, China, Oct. 8, 1905; coll. A. Owston.

Whole top of head mixed fulvous and dusky, fulvous prevailing; nape and shoulders mixed gray and dusky, pale yellowish gray prevailing, producing a rather

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[1] Recherches Mammifères, pll. vii.

conspicuous gray mantle; posterior two-thirds of dorsal region rusty-fulvous and dusky, the rusty-fulvous strongly prevailing; flanks paler fulvous grizzled with dusky, passing gradually into the strong yellowish buff of the whole ventral surface; eye-ring broad, well-defined, pale yellowish white; an indistinct fulvous band from side of nose to ear; below this an ill-defined blackish cheek-stripe; ears moderate, nearly naked, grayish posteriorly, inner surface dull fulvous; a large postauricular spot of white, the hairs soft and fluffy; tail above mixed fulvous, black and white, the hairs being fulvous for the basal two-thirds, then broadly ringed with black and conspicuously tipped with white; lower surface of tail pale fulvous, with a submarginal band of black and an outer fringe of white; feet finely varied with pale fulvous and dusky, giving a grizzled yellowish gray brown effect. The pelage is rather short, the under fur plumbeous, the shorter hairs black basally and tipped with fulvous, mixed sparingly with coarser longer hairs wholly black, which add a grizzled effect to the surface coloration; pelage of the ventral surface and inside of limbs plumbeous at base, broadly tipped with yellowish, varying in different specimens from pale yellow to ochraceous.

Measurements from a well-made skin: head and body, 175 mm.; tail vertebræ, 145; tail to end of hairs, 200; hind foot (s. u.), 47 (c. u., 50). The skulls are all imperfect, lacking the occipital region. The skull of the type measures: tip of nasals to parieto-occipital suture, 52; zygomatic breadth, 30; interorbital breadth, 13; postorbital breadth, 15; length of nasals, 17; palatal length, 27; upper toothrow, 9.

Represented by six specimens, all from the type locality, Tai-pa-shiang, Shensi Province, China.

Sciurotamias owstoni is allied to *S. davidianus*, type of the genus *Sciurotamias*, from the mountains near Pekin, but is much more richly colored throughout. (Compared with a Pekin specimen in the U. S. National Museum, which is very much grayer and less fulvous.)

9. **Eutamias albogularis** sp. nov.

Type, No. 27565, ♂ ad., Tai-pa-shiang, Shen-si, China, July 13, 1905; coll. A. Owston.

With five broad black dorsal stripes. The median black stripe extends from between the ears to the base of the tail, 8–10 mm. wide over the mid-dorsal region, narrower and less strongly defined toward either end; inner lateral black stripe nearly as wide as the median but shorter, extending from front of shoulders to loins; outer lateral stripe also broad and black but much shorter; the light bands between the dark stripes are gray anteriorly and more or less fulvous or pale rufous posteriorly; the outer light stripe broader and lighter than the inner ones. Three stripes on each side of the head dusky mixed with pale rusty. Top of nose with a small spot of blackish; top of head pale rufous, varied with black-tipped hairs; a faint superciliary streak of dusky; line through and enclosing eye pale buffy white, divided behind the eye by a short dusky stripe; below this a broad cheek-stripe of mixed dusky and rufous, extending from the side of the nose to below the ear; sides of head below the cheek-stripe cream buff, continued faintly posteriorly to front of shoulder; top of shoulders nearly to middle of back gray; posterior part of back, rump and

outer surface of hind limbs yellowish rufous; flanks and outer surface of fore limbs pale grayish, the basal portion of the fur plumbeous; upper surface of tail grizzled black and white, fulvous beneath the surface, and broadly fringed with white; upper surface of fore and hind feet duller and yellower than lower median area of tail; ears externally dusky toward the base, apical third whitish; inner surface dusky gray basally, varied with fulvous apically, with a very narrow whitish border on the posterior margin; an indistinct postauricular grayish patch, whitish in half-grown specimens.

Head and body (of type, from skin), 160 mm.; tail vertebræ, 120; ear, 15; hind foot (s. u.), 33. The skulls are too imperfect for measurement.

Represented by six specimens, all from Tai-pa-shiang, taken May 29, July 10–13, and Oct. 10. Four are adult, and two are one-third to half grown. The October specimen is brighter and richer colored than the May and July examples, the rufous of the lower back and the yellow of the ventral surface being much deeper and the gray of the scapular region less clear.

Eutamias albogularis agrees in general features with *E. orientalis* (Bonhote), from the upper Ussuri River, Siberia, but it differs from that form in having the whole ventral surface pale yellow instead of clear white, the lower back stronger ferrugineous, and five distinct dorsal stripes instead of three. It needs no comparison with either *E. asiaticus* (Gmelin) or *E. senescens* Miller.

10. **Citellus mongolicus** subsp. nov.?— An adult female, "Foot of Tai-pa-shiang," Nov. 18. While referable to the *C. mongolicus* group, it differs from it somewhat in coloration, and is doubtless separable, but the specimen lacks part of the tail and is otherwise unsatisfactory as the basis of a new name.

11. **Felis** sp.— One specimen (skin only, with imperfect tail), Tai-pa-shiang, August.

12. **Lutra lutra** (*Linnæus*). One specimen (skin only), female, Yumonko, Tai-pa-shiang, October 2. (Probably the *Lutra hanensis* Matschie).

13. **Lutreola moupinensis** (*Milne-Edwards*).— Two specimens, Yumonko, foot of Tai-pa-shiang, November.

14. **Lutreola davidiana** (*Milne-Edwards*). One specimen, male, Si-Tai-pa-shiang, Nov. 18.

15. **Meles leucurus** *Hodgson*.— An old female, skin and skull, Yumonko, Tai-pa-shiang.

16. **Vulpes lineiventer** *Swinhoe*.— An adult female, skin and skull, Yumonko, Tai-pa-shiang, August 8.

INDEX TO VOLUME XXVI.

New names of genera, species and subspecies are printed in **heavy-face** type; also the principal references in a series of references.

ERRATA.

Page 151, line 12, for **thompsoni** read **thomsoni**, and for Thompson read Thomson.
" 201, legend of Fig. 23, for dorsal read lateral.
" 339, lines 2 and 14, for Papagon read Papahag.
" 340, line 1, for Sablon read Soblon.
" 341, " 14, for Santa Cruz Laguna read Santa Cruz, Laguna.
" 341, " 15, for Ramblon read Romblon.
" 342, " 7, for Ramblon read Romblon.
" 342, lines 17 and 19, for Santa Cruz Laguna read Santa Cruz, Laguna.

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